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Financial Stability and Interest-Rate Policy: A Quantitative Assessment of Costs and Benefits

by Andrea Pescatori and Stefan Laséen

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A Financial Stability and Interest-Rate Policy: A Quantitative Assessment of Costs and Benefits

Prepared by Andrea Pescatori and Stefan Laseen

Authorized for distribution by Cheng Hoon Lim

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Abstract

Should monetary policy use its short-term policy rate to stabilize the growth in household credit and housing prices with the aim of promoting financial stability? We ask this question for the case of Canada. We find that to a first approximation, the answer is no—especially when the economy is slowing down.

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Author’s E-Mail Address: apeascatori_at_imf_org, slaseen_at_imf_org.

1 Introduction

The global financial crisis has reignited the debate on whether a central bank should pay special attention to asset prices and credit aggregates. Indeed, the benign neglect approach of the mid-2000s seems to have been debunked by what we know today of the by subsequent events. This opens the door to a leaning-against-the-wind (LAW) approach to monetary policy—i.e., a policy where the policy stance is chosen to be tighter than the one justified by the stabilization of inflation and resource utilization (traditional central bank's goals) to limit the buildup of financial risks. Proponents of LAW argue that even though the policy rate may not be the best tool to deal with financial risks—especially when compared to micro- and macro-prudential tools—it has the advantage of 'getting in all of the cracks' (BIS 2014, Stein 2013, 2014). On the other side of the camp, Svensson (2014, 2015, 2016) argues that, for the case of Sweden, the benefits of a tighter-than-otherwise policy are dwarfed by their costs; Ajello et al. (2015) find that financial stability considerations are not quantitatively relevant to meaningfully alter the usual conduct of monetary policy. Falling somewhere in the middle, IMF (2015) stresses that country specificities matter substantially to correctly assess costs and benefits of alternative monetary policy paths, setting the bar high to lean against the wind but leaving the door open to the possibility of finding circumstances where benefits outweigh costs.

In this paper, we assess the relative welfare benefits of LAW in Canada. At the current conjuncture Canada represents an interesting case: Monetary policy faces the dilemma of supporting a struggling economy by cutting interest rates and maintaining financial stability in a context of high household debt and ever growing housing prices (Figure 1 and 2).

The present paper contributes to the literature in various ways.

(1) It extends Schularick and Taylor's (2012) estimates of crisis probabilities and shows that adding debt (private debt-to-GDP) improves the empirical fit and brings additional insights: It has a non-linear effect in that it is mainly at high levels of debt that higher credit growth affects the crisis probability—

a 1 percentage point increase in credit growth implies just a 0.02 percentage point increase in crisis probability when debt-to-GDP is low (e.g., 30 percent) but the crisis probability doubles when debt-to-GDP is high (e.g., 100 percent). (2) It evaluates the central bank loss function dynamically using a two-state Markov chain that better captures the uncertainty of the state of the economy (normal vs. crisis state).[1] Finally, (3) it uses a Bayesian VAR (estimated on US and Canadian data) to assess the effectiveness of the policy rate in driving macroeconomic variables taking into full account parameter uncertainty in the welfare comparison.

Our findings show that it is very unlikely that the benefits of having a meaningfully tighter policy (i.e., at least 25 basis points higher than otherwise) would outweigh its costs, in the current Canadian context. In fact, even though the interest rate increase reduces the growth of real household credit and house prices and the ratio of household debt to GDP, the reduction in the crisis probability is minor and peaks only after about 8 years. At the same time, costs are front loaded and magnified by the tighter economic conditions. The policy rate path which takes into account financial stability risks is, thus, only 6 basis points higher than otherwise (for 8 quarters)—which, quantitatively, is not a meaningful policy alternative. A policy rate that is 25 basis points higher than otherwise (for 8 quarters) is expected to be welfare improving only under a scenario where a crisis would impose *severe* costs on the economy and real credit is expected to grow (in absence of policy intervention) at or above 9 percent a year for the next 3 consecutive years.

Finally, a caveat: A specific analysis of the Canadian macroprudential framework and its possible interaction with monetary policy goes beyond the scope of the paper. It is, however, worth mentioning that the country-fixed effects of the logit regression are not statistically significant and, thus, not useful for improving our ability to understand whether differences in institutional frame-

[1] By comparison, recent papers such as Svensson (2014, 2015) and Ajello et al (2015) have used a static or two period approach. Svensson (2016) follows Diaz Kalan et al. (2015) and uses a multi-period framework.

works (such as the institutional arrangement for macroprudential policy), affect crisis probabilities.

The paper is structured as follows: In section 2 we establish which variables are good crisis predictors; in section 3 we assess how monetary policy shocks affect credit variables and other target variables; in section, 4 we evaluate policy tradeoffs; and in section 5 we conclude.

2 Predicting Financial Crises

To quantitatively assess which factors affect the probability of a crisis we follow Schularik and Taylor (2012) and postulate that in a given country the probability, p_t, of observing a financial crisis in year t can be expressed as a logit function of a vector of observable variables

$$p_t = logit(X_t; \alpha)$$

where α is a vector of parameters and X_t is the vector of observable variables. To estimate α we perform a regression using Schularick and Taylor's (2012) cross-country longitudinal dataset.[2] Estimates are shown in Table 1. The first regression replicates their results where credit growth (i.e., the change in the log-real bank loans extended to households and non-financial corporate sector) affects significantly the crisis probability with a two year lag. We extend the first specification by including debt-to-GDP. This specification shows that not only the flow of credit but also its cumulated stock is an important predictor of crises. Moreover, we find a better fit when debt is introduced exponentially (both the pseudo likelihood and R-squared improve). This specification does not reduce (it actually strengthens) the credit growth coefficient suggesting that it is mainly

[2] The data sample is annual, from 1870 to 2008 (adding 2009 does not change the results) and includes 14 advanced economies (see Schularick and Taylor 2012). All three specifications include country fixed effects even though they turned out to be not statistically significant and, thus, are not reported. In our sample the crisis frequency is 4.06 percent per year (it rises to 4.49 percent if 2009 is added), Canada's crisis probability is lower at 2.4 percent having experienced only three financial crises in 1873, 1907, and 1923.

at relatively high level of debt that fast credit growth becomes a good predictor of crises. The calculation of the marginal effects of higher credit growth on the crisis probability confirms this intuition: When debt is low a 1 percent increase in credit growth raises the crisis probability by only 0.02 percentage points while in the presence of high debt this effect is doubled (Table 2 first row).[3] Similarly a 10 p.p. increase in debt-to-GDP has a quadrupled effect if it starts from an already high level raising the crisis probability by almost 0.2 percentage point (Table 2 second row).

By feeding Canadian data into the estimated regressions we can plot the probability of observing a financial crisis in Canada over time (Figure 3):[4] In the last decade, the level of the crisis probability has shifted up because of rising household debt—a legacy of the housing boom of the 2000s. This can be easily seen by noting how the point estimates of the crisis probability start diverging in mid-2000s when debt is added to the specification.

It is also worth noting that point estimates are characterized by high standard errors which introduce the risk of underplaying the possibility of a crisis when focusing only on point estimates. We will take into account parameter uncertainty and the role that it plays in our welfare comparisons.

The last regression of Table 1 introduces the one-year lagged real rate and its interaction with debt. Even though the direct effect of a real rate increase would tend to reduce the crisis probability, the positive coefficient on the interaction term implies that the benign effects on the crisis probability of a real rate increase can be overturned by a high stock of debt. This result, though interesting, is not fully supported by the data given that coefficients on both

[3] Low and high level of debt are defined as the average Canadian household credit-to-GDP in 1983 (about 20 percent) and in 2015 (about 100 percent), respectively. Marginal effects are defined as $\partial p/\partial x_i = \alpha_i \overline{p}(1-\overline{p})$, where $\overline{p}$ is the crisis probability evaluated in a given point. For credit growth the marginal effects are calculated summing all the 5 coefficients on lagged credit growth.

[4] To convert the estimates from annual to quarterly frequency we have used year over year changes and averages for credit growth and debt-to-GDP. The probabilities are then divided by 4.

the real rate and the interaction term are not statistically significant.

The specification with the addition of debt seems to be the most appealing not only theoretically but also in terms of fit since the value of its pseudo R-squared is the highest among the three specifications. Hence we will use it as our baseline regression in the policy analysis of section 4.

3 The Effectiveness of the Interest Rate as a Policy Instrument

In what follows we assume that the monetary authority has the short-term interest rate as the only instrument available to address its policy objectives. Having found the factors that help predict financial crises, to establish the link between the policy instrument and policy objectives, we now turn to assess whether and by how much an interest rate shock affects credit growth and household debt (i.e., intermediate target variables for the financial stability goal) above and beyond its impact on inflation and unemployment (i.e., traditional monetary policy goals).

To study the effects of a policy rate shock we adopt a Bayesian VAR which includes US economic indicators and oil prices as exogenous variables in addition to (endogenous) Canadian economic indicators.[5]

We find that a typical monetary policy shock increases the short-term interest rate by 50 basis points initially, with a half life of about 1.5 years (Figure 4).[6]

[5] The BVAR is estimated from 1985Q1 to 2015Q2 and includes 3 lags. The exogenous or external block has tight priors that are independent of Canadian variables and includes the US unemployment rate, the 3-month US Tbill, and the log-difference of WTI oil price, US real GDP, and CPI index. The Canadian block includes the unemployment rate, the short-term treasury yield, the log of credit-to-GDP, and the log-difference of real GDP, CPI index NSA, CPIX index, real house prices, credit divided by CPI, and real exchange rate. Credit is defined as total credit extended to households by Bank of Canada.

[6] A recursive identification is used to identify the monetary policy shock by having the short-term Canadian interest rate placed in the penultimate position before the real exchange rate.

The effect of the monetary policy shock on the traditional target variables are as follows. The peak impact of the shock on unemployment is about 0.2 percentage points after almost 4 years while real GDP growth drops below -0.2 percent after 3 quarters. The response of inflation is relatively muted, the point estimate shows a mild price puzzle which is in part due to the increase in mortgage payments—which, in Canada, are still included in the shelter component of CPI.[7] Even so, eventually price inflation falls below its long-term 2 percent target.[8]

We now turn to the effect of the monetary policy shock on credit. Both real credit growth and debt-to-GDP decline after an interest rate shock. Real credit declines by about 0.4 percentage points, peaking after 3 quarters. The reduction in real credit growth is strongly associated with a slowdown in real house prices. The reduction in debt-to-GDP is more modest and it peaks after 10 years (before reverting to its steady state level). After 10 years, the stock of debt is almost 1 percent lower than in the absence of the shock.[9]

The historical decomposition of household debt and real credit growth shows that most of their movements in the last 5 years can be explained by external

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The identification scheme used follows closely the one used in the literature (see Christiano et al 1999 or Coibion 2012 for a discussion).

[7] The muted price response has proven to be quite robust to changes in the BVAR specification and sample period (such as using GDP deflator or SA CPI data on a shorter sample period). The price puzzle does not particularly affect CPIX which excludes mortgage payments (among other items). It is also likely that the precision of the estimates of the impact of monetary policy shocks on prices is diminished by the well anchored medium- and long-term inflation expectations.

[8] We have imposed a tight prior on steady state inflation symmetrically centered at 2 percent.

[9] A clarification: The difference between the cumulated response of real credit growth and real GDP growth is not exactly equal to the debt-to-GDP ratio because credit growth is deflated by CPI while GDP is deflated by the GDP deflator. Also, the BVAR implicitely assumes that after a monetary policy shock the debt-to-GDP ratio converges back to steady state while the cumulated difference between real credit growth and real GDP growth (i.e., real debt-over-real GDP) is not forced to converge to its steady state. These assumptions have no bearing on the results since, the rate of convergence to steady state of debt-to-GDP is extremely slow.

factors such as low U.S. interest rates and persistently high oil prices (Figure 5). The rise in the mid-2000s, however, is mainly explained by domestic factors such as high house price and credit growth and by a low frequency movement possibly proxying financial deepening or financial market deregulation. Therefore the BVAR does not attribute much of the rise in household debt and house prices to monetary policy shocks per se since the policy rate response to economic conditions in the mid-2000s does not seem to have been substantially different from the its typical response.

In the next section we use the BVAR projections and the elasticities (IRFs) of the endogenous variables to the monetary policy shock to determine the behavior of target variables, credit variables, and, thus, the crisis probability, during normal times.

4 Evaluating the Policy Tradeoffs

To assess the policy alternatives we follow the methodology developed in Diaz-Kalan et al. (2015) and in IMF (2015) which is an extension of the approach first presented in Riksbank (2013) and Svensson (2014). The idea is to evaluate and compare the assumed central bank's loss function under two alternative interest rate paths. The first path is calculated as the optimal path in the absence of financial stability considerations (the LQ-path or also the benign-neglect policy) while the alternative path is chosen to be 'somewhat' tighter than the other one (the LAW-path). We will perform this exercise in the context of our BVAR drawing forecasts of the variable of interests *conditional* on the chosen interest rate path and taking into account parameter uncertainty.

It is worth noting that given the way interest rate paths are constructed—i.e., a set of monetary policy shocks are used to construct the conditional forecasts—the policy is not immune to the Lucas's critique. While the benign neglect policy (i.e., LQ-path) is supposedly close to the actual policy implemented by Bank of Canada, the LAW-path may differ more substantially and, thus, is more vulnerable to the Lucas's critique. It is beyond the scope of the paper to analyze the effect of changes in the systematic component of monetary policy on financial stability (see Laseen et al 2015 for an example).

4.1 The Loss Function

We define the *momentary* loss function as

$$L_t(\iota_0) = (\pi_t - \pi^*)^2 + \lambda(u_t - u^*)^2$$

where π_t is the inflation rate and u_t is the unemployment rate (our chosen measure of economic activity).

The *life-time* welfare loss can, thus, be defined as

$$\mathfrak{L}_0(\iota_0) = E_0 \sum_{t=0}^{T} \beta^t L_t(\iota_0)$$

where $\iota_0 = \{i_t\}_{t=0}^{\overline{T}}$ describes the chosen interest rate path and $\overline{T}$ is the policy horizon.

We assume that the economy follows a two-state Markov chain where the transition matrix M_t governs the probabilities of passing from the normal state to the crisis state and vice versa. The time-t transition matrix is defined as

$$M_t(\iota_0) = \begin{pmatrix} 1 - p_t(\iota_0) & p_t(\iota_0) \\ \delta & 1 - \delta \end{pmatrix}$$

where p_t represents the probability of going from the normal state to the crisis state while δ represents the probability of going back to the normal state from a crisis state. The functional form and estimation of p_t has been performed already in section 2 while the notation $p_t(\iota_0)$ stresses that ultimately the probability of transition from the normal state to the crisis state depends on the chosen interest rate path since it affects credit variables. The m-period-ahead transition probabilities $M_{t,t+m}$ can be expressed recursively as

$$M_{t,t+m} = M_{t+m} M_{t,t+m-1}$$

Hence, assuming that we evaluate policy alternatives conditional on being in normal times, we can write our welfare loss as

$$\mathfrak{L}_0(\iota_0) = E_0 \sum_{t=0}^{T} \beta^t L_t = [1, 0] \widehat{E}_0 \sum_{t=0}^{T} \beta^t M_{0,t}(\iota_0) L_t(\iota_0)$$

where the expectation operator $\widehat{E}$ is understood to be defined on both shock and parameter uncertainty perceived by the monetary authority.[10] As mentioned, during normal times the evolution of target variables comes from the BVAR conditional forecasts (see section 3 for a description of the BVAR). This seems to be a reasonable description of normal times since the BAVR has been estimated over a period where Canada experienced no financial crisis. The BVAR, however, is clearly no longer reliable to describe the evolution of our variables of interest during crisis times. For simplicity, we assume that during a crisis our traditional target variables (inflation and output) are a constant above their target levels (see section Calibration).[11]

We define the optimal policy that would prevail in the absence of financial stability consideration as a linear-quadratic (or benign-neglect) policy. This is simply derived as the optimization of $\mathfrak{L}_0(\iota_0)$ conditional on $p_t \equiv 0$ at all times.

$$\iota_0^{LQ} = \arg\max_{\iota_0} \mathfrak{L}_0(\iota_0) = \arg\max_{\iota_0} \widehat{E}_0 \sum_{t=0}^{T} \beta^t L_t(\iota_0)$$

In the presence of financial stability considerations we have to take into account the transition matrices $M_{t,t+m}(\iota_0)$ which are indirectly affected by the chosen path for the policy rate through its impact on credit variables.

$$\mathfrak{L}_0(\iota_0^{LAW}) = [1,0]\widehat{E}_0 \sum_{t=0}^{T} \beta^t M_{0,t}(\iota_0^{LAW}) L_t(\iota_0^{LAW})$$

The welfare comparison is thus the difference between welfare losses under the linear quadratic path ι_0^{LQ} (the LQ path) and the welfare losses under the alternative path ι_0^{LAW} (the leaning-against-the-wind path), with $\iota_0^{LAW} \geqslant \iota_0^{LQ}$. The welfare comparison, expressed in terms of welfare losses, can, thus, be expressed as

[10] In the loss function comparison we abstract from shock uncertainty (i.e., in the BVAR projections we do not draw from the distribution of shocks). Preliminary calculations suggest that even though shock uncertainty has a significant effect on the *level* of losses, it is parameter uncertainty that matters for the welfare loss *comparison* of alternative policy paths.

[11] Notice that our approach does not require imposing a constant inflation and unemployment in crisis times; instead we assume that they follow a well-behaved stochastic process.

$$\mathfrak{L}_0(\iota_0^{LQ}) - \mathfrak{L}_0(\iota_0^{LAW})$$

4.1.1 Calibration

Since 25 basis points is the smallest policy rate movement considered by most central banks, including Bank of Canada, we assume under our baseline that the leaning-against-the-wind (LAW) policy consists of being 25 basis points tighter than otherwise $\iota_0^{LAW} = \iota_0^{LQ} + 0.25$ for 8 quarters.

The Bank of Canada, by focusing on core inflation as an intermediate target, has practically adopted a flexible IT framework with the goal of keeping CPI inflation between 1 percent and 3 percent over the medium term leaving space for short-term economic stabilization. Hence, we choose the policy horizon $\overline{T}$ to be 3 years, $\pi^* = 2\%$, and we set the same weight between the inflation and output goals $\lambda = 1$set the unemployment target at $u^* = 6\%$. For comparability, this would have been roughly equivalent to 5 percent if we had used the U.S. definition of unemployment (Zmitrowicz and Khan 2014).[12] Finally, we also assume $\beta = 0.996$, which means that the monetary authority discounts (real) future losses at an annualized rate of 1.5 percent in line with recent estimates of the neutral rate in Canada (Mendes 2015).

We set δ, the probability of reverting to normal times, to 0.06 which implies an average crisis duration of 4.2 years. This is in line with various empirical evidence that point to slow recoveries from financial crises.

To calibrate the cost of a crisis we assume that during a *moderate* crisis inflation is 2 percentage points below its target while unemployment is 5 percentage points above its target for the entire duration of the crisis. Furthermore, in a *severe* crisis we assume that unemployment is 7 percentage points above the target (this is in line with IMF 2015).

[12] The unemployment rate has been trending down since the '80s. Most likely the desired unemployment rate has also declined over time. However, since our analysis is forward looking, we do not have to take a stand on the historical evolution of the unemployment target u^*.

It is worth stressing, however, that there are alternative ways of conceptualizing the costs of a crisis that have been proposed in the literature: (1) In a crisis the unemployment (inflation) rate increases (decreases) relative to its last pre-crisis observation rather than the natural target rate (Svensson 2016); (2) the increase (decrease) in the unemployment (inflation) rate is proportional to the pre-crisis credit growth rather than being a fixed magnitude (BIS 2014 and IMF 2015).[13]

Alternative (1) has built-in a leaning-*with*-the-wind effect. Since a LAW policy increases the unemployment rate during normal times relative to the benign-neglect policy, when a crisis occurs, the unemployment rate will necessarily be starting at a level higher than if the authorities have not implemented a LAW policy. Loosely speaking, approach (1) assumes that LAW makes the cost of crises more severe (even though less likely).[14] This pushes the bar higher for a leaning-against-the-wind policy.

Alternative (2), on the other hand, favors to lean against the wind since it assume that the higher the credit growth is the more severe the next crisis will be. This implies that leaning against the wind not only may prevent crises from happening but also, when they do happen, they will be less severe. This approach clearly lowers the bar for a leaning-against-the-wind policy.[15]

Overall, we believe that our chosen calibration for the cost of a crisis strikes a balance between the two alternatives described above.

Finally, it is worth mentioning that the Canadian mortgage sector has an extended government guarantee for mortgages insured through the Canada Mortgage and Housing Corporation (CMHC) a crown corporation, and a 90 percent

[13] At support of the BIS's view, there are several studies, based on American household data, that show that consumption was more negatively affected during the financial crisis for highly indebted households. Results in Dynan (2012) and Mian et al. (2013) indicate that the consumption loss was larger than what can be explained by wealth effects from falling house prices.

[14] See Svensson (2016) for an exhaustive analysis of this case.

[15] A drawback of this approach is that there is little guidance in the empirical literature on how to precisely link the behavior of unemployment and inflation during a financial crisis to the credit growth preceding the crisis.

Federal guarantee on the mortgage insurance provided by two private insurers. It is, thus, plausible to assume that the costs of a financial crisis would be mitigated by the Federal government guarantee. However, an explicit government intervention does not necessarily isolate the broader real sector from financial turmoil—as the experience of the Nordic countries in the '90s and more recently Ireland would suggest.[16] We will, thus, assume a moderate cost of a crisis under our baseline case and explore the case of a severe crisis only in a scenario.

4.1.2 Result 1. The baseline case

The welfare comparison suggests that it is very unlikely that a LAW policy would be beneficial in Canada under current circumstances (Figure 6).[17] In other words, even though household debt is high and credit grew at a brisk pace recently, the additional slowdown in real economic activity induced by LAW would be too costly. The increase in the average welfare loss due to LAW is about 0.39 percent (relative to the benign-neglect policy). In the specification without debt the relative loss due to LAW increases to about 0.56 percent. It is worth noting, however, that parameter uncertainty is substantial. Indeed, the histogram of Figure 6 shows a few draws from the parameter space where the losses under the benign-neglect policy are bigger, $\mathfrak{L}_0(\iota_0^{LQ}) > \mathfrak{L}_0(\iota_0^{LAW})$. These draws reflect a combination of parameters where unemployment and inflation are little affected by monetary policy shocks while the crisis probability is at the highest percentiles of its estimated distribution.

To understand the results it is also worth emphasizing that the benefits of LAW are mostly accrued slowly over time in terms of lower crisis probability with a peak effect after almost 8 years. Costs, instead, are clearly paid upfront in the first 2 years of tighter policy (Figure 7).[18]

[16] In addition, government guarantees has the drawback of inducing moral hazard in the financial sector which may increase risk-taking and raise the probability of a crisis, *ceteris paribus*.

[17] Recall that the LAW policy considered is a policy rate path 25 basis points higher than otherwise, $\iota_0^{LAW} = \iota_0^{LQ} + 0.25$, for 8 quarters.

[18] The starting value for the unemployment rate is $u_t = 6.8$ and is projected to rise to 7.0

4.1.3 Result 2. The optimal response is 6 basis points!

In the previous section we assumed that the LAW path was 25 basis points higher than otherwise. Since 25 basis points is an arbitrary choice we searched for the optimal deviation from the benign-neglect policy once we introduce financial stability considerations in the loss function (still maintaining the restriction of 8 quarters policy horizon to test LAW). So among all the alternative policy paths that differ from the LQ path by x basis points, $\iota_0^A = \iota_0^{LQ} + x/100$, we searched for the one that delivers the lowest welfare loss. We found that the policy path that gives the lowest welfare loss (under our preferred calibration) is only 6 basis points higher than the LQ path. In other words, to take account of financial stability concerns, the policy rate should be a mere 6 basis points higher, improving welfare by only 0.02 percent relative to the taditional benign-neglect policy (Figure 8).

The intuition is simple. The momentary loss function is quadratic in inflation and unemployment (conditional on being in normal times) which means that very small deviations of inflation and unemployment from their targets are inconsequential for the welfare loss (Figure 9).[19] Indeed, in the limit, the *marginal* costs of increasing the policy rate are zero when inflation and unemployment are *exactly* at their targets. The *marginal* benefits of a higher policy rate, however, are always strictly positive since the effect of a higher policy rate on the crisis probability is always strictly positive—except in the uninteresting limit case when the crisis probability is exactly zero. So in principle it is always possible to find a sufficiently small policy rate increase for which its marginal benefits are strictly greater than its marginal costs. What we found, however, is that the policy rate increase that eventually equates marginal benefits with marginal costs is just 6 basis points higher than otherwise—which is of little quantitative relevance.

in the next quarter, while CPI inflation is projected to fall below the 2 percent target in the following 2 quarters under the LQ policy.

[19] The LQ path usually guarantees that inflation and unemployment stay close to their targets.

4.1.4 Result 3. A high-credit-growth and severe crisis scenario

Given the sizeable terms of trade shock coupled with weak economic conditions the BVAR is currently projecting a slowdown in credit growth in the forthcoming years. This projection, though reasonable, clearly has a bearing on the results. Credit growth, however, is strong in buoyant housing markets such as Vancouver and Toronto. It is, thus, interesting to construct a scenario with higher credit growth and where the costs of a crisis are potentially severe rather than moderate. This exercise will help us understand the sensitivity of the previous results to different initial conditions and assumptions. Under this scenario not only are the benefits of LAW increased because of the potential severity of the crisis but also—since marginal effects are increasing in the crisis predictors—higher real rates have a stronger effect on reducing the crisis probability (see Figure 11). It is useful to describe the results in terms of a credit growth threshold above which leaning against the wind becomes beneficial. We find that when real credit growth exceeds 9.1 percent the benefits of a LAW policy (i.e., a policy rate 25 basis points higher than otherwise for 8 quarters) outweigh their costs (see Figure 10).

5 Conclusion

The recent monetary policy debate has reignited the question of whether a central bank should tighten monetary policy to reduce financial stability risks. We have attempted to answer this question for Canada and, under current conditions, the answer is most likely no.

Our analysis has also shown how initial conditions (in relation to credit aggregates and other macroeconomic variables), non-linearities in the relation between the crisis probability and its determinants, and long lags and parameter uncertainty play a substantial role in the comparison of policy alternatives. In particular, we have shown that (1) the level of debt interacts with credit growth: the higher the debt level the stronger the marginal effect of credit growth on the crisis probability, (2) a monetary policy shock affects the crisis probability with long lags (the peak effect is after 8 years), but (3) costs in terms of lower inflation and economic activity are front loaded (4) both the relation between credit and crisis probability and the effect of a monetary policy shock on credit aggregates show substantial parameter uncertainty. The last 3 points give an indication of the substantial credibility, implementation, and communication challenges that Bank of Canada that would need to consider to successfully lean against the wind..

Finally, it is worth mentioning that alternative policy paths are constructed using monetary policy *shocks.* The Lucas's critique, however, taught us that economic agents cannot be systematically surprised. Hence, a *systematic* use of a *non-systematic* policy would sooner or later be subjected to the Lucas's critique. More research is, thus, needed to understand the implications of a systematic reaction to financial risk taking.

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6 Appendix

We have used the following data series in the BVAR analysis:

U.S. GDP – Bureau of Economic Analysis real chained gross domestic product

(2005 dollars, SAAR).

U.S. unemployment rate – Bureau of Labor Statistics.

U.S. CPI – Bureau of Labor Statistics all-item consumer price index.

Oil price – Spot West Texas Intermediate.

Canada GDP – Statistics Canada real chained gross domestic product (2007 dollars, SAAR).

Canada unemployment rate – Statistics Canada.

Canada CPI – The non-seasonally adjusted Statistics Canada all-item consumer price index

is used as the seasonally adjusted series only dates back to 1992.

Canada Core: Bank of Canada core CPI excluding indirect taxes.

Canada Household Credit: Bank of Canada household credit series

Canada real effective exchange rate – Bank of Canada, Canadian dollar effective exchange

rate index (CERI, 1992 = 100)

Canada HPI: Canadian Real Estate Association national house price index.

For the logit regression we were not able to map the dataset from Schularick and Taylor into our credit data for Canada. In particular, their variable 'loansgdp' which represents bank loans to household and private non financial corporations as ratio of GDP is about 70 percent in 2008 while StatCan equivalent series is about 130 percent in the same year. Hence, instead of using total private credit we use Bank of Canada household credit series which is about 76 percent in 2008, closer to the values in Schularick and Taylor (2012).

6 Tables and Figures

Table 1 Financial Crisis Prediction – Logit Estimates

	Credit Growth		Debt-to-GDP		Real Rate	
	coef.	**s.e.**	**coef.**	**s.e.**	**coef.**	**s.e.**
L. Δlog (loans/P)	-0.398	(2.110)	-0.204	(2.261)	-0.649	(2.255)
L2. Δlog (loans/P)	7.138***	(2.631)	7.543***	(2.795)	8.097***	(2.867)
L3. Δlog (loans/P)	0.888	(2.948)	0.816	(3.233)	1.136	(3.182)
L4. Δlog (loans/P)	0.203	(1.378)	0.157	(1.467)	0.105	(1.542)
L5. Δlog (loans/P)	1.867	(1.640)	2.550	(1.754)	2.706	(1.829)
L2. Exp (Loan/GDP)			0.615***	(0.233)	0.454*	(0.262)
L. Short Term Real Rate					-0.954	(8.360)
Interaction: L.Real rate & L2.Loan/GDP					3.513	(4.039)
Constant	-3.968		-4.953		-4.812	
Observations	1,272		1,272		1,031	
Groups	14		14		14	
$R^{2\ \dagger}$	0.0659		0.0824		0.0818	
Pseudolikelihood	-205.8		-202.2		-189.1	
Test for country effects = 0 ††	7.674		12.55		10.72	

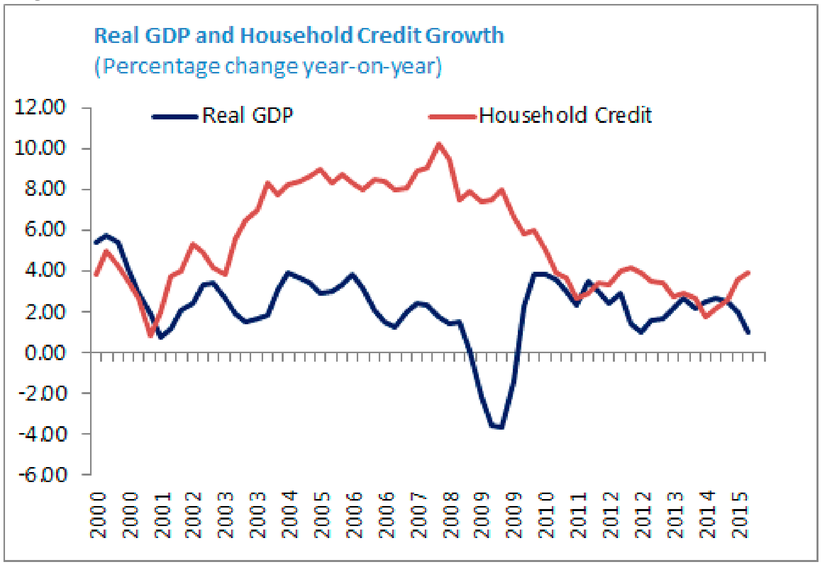
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
† Pseudo R^2
†† Chi-squared statistic.

Table 2 Marginal Effects on Crisis Probability by debt-to-GDP

Marginal effects on crisis probability		
	Initial debt-to-GDP	
	Low debt	**Low Debt**
+1% Credit	0.02 [0.01 , 0.07]	0.04 [0.01 , 0.12]
+10 p.p. Debt	0.06 [0.01 , 0.21]	0.20 [0.04 , 0.88]

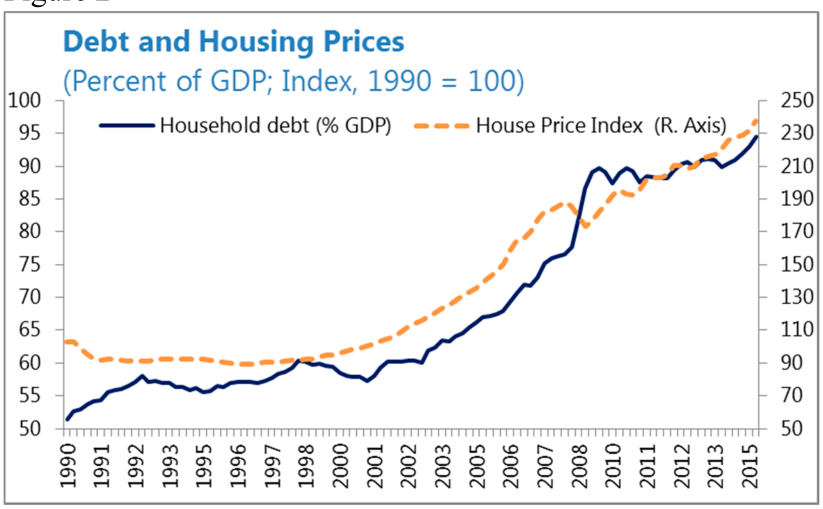
Marginal effects are median estimates. Square brackets represent the 5^{th} and 90^{th} percent confidence bands. Low (High) debt is the Canadian household debt-to-GDP in 1985 (2014); credit growth is at its sample mean.

Figure 1



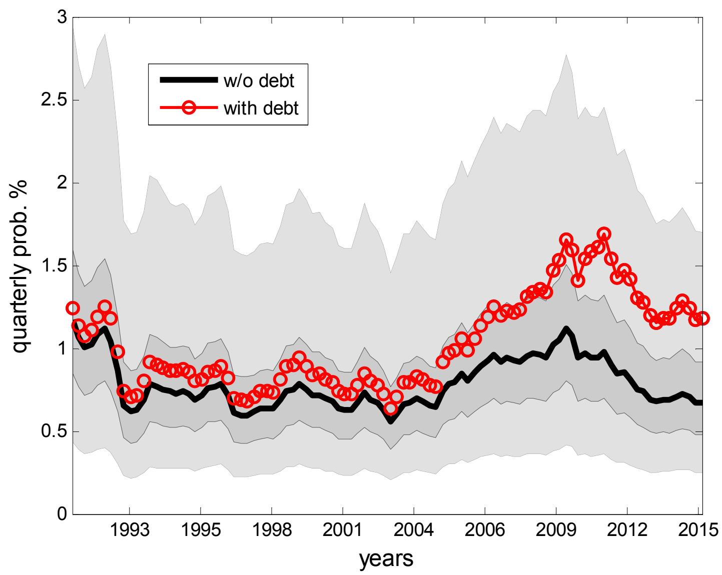
Source: StatCan, Bank of Canada, and IMF

Figure 2



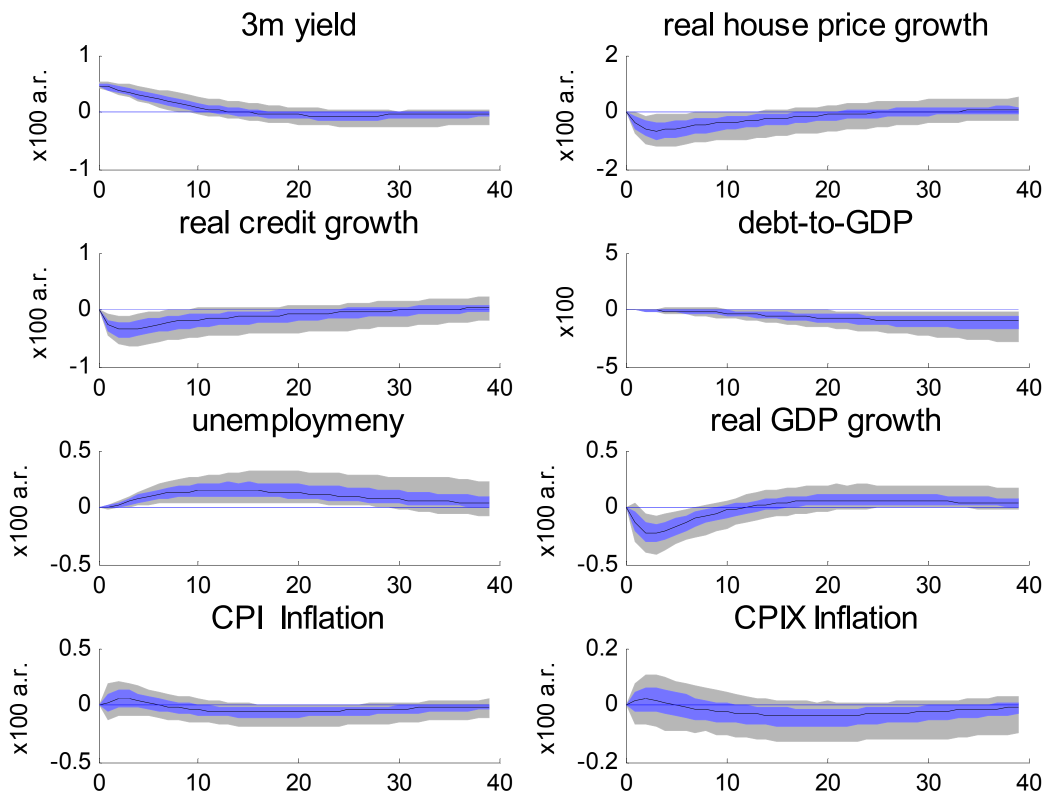
Note: house price index deflated by CPI.
Source: CREA, Bank of Canada, and IMF

Figure 3 Crisis Probability in Canada with and w/o debt-to-GDP



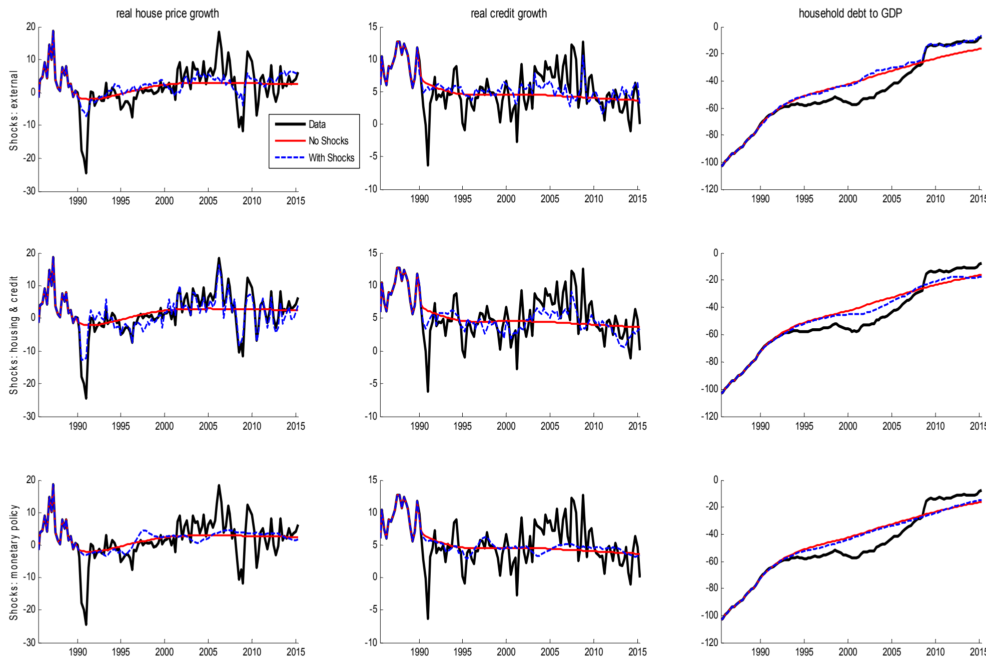
Note: The black line is the point-estimate probability of observing a financial crisis in the next quarter. Grey shaded areas represent 66th and 90th confidence bands. The red-circled line is the point-estimate probability of observing a financial crisis, in the baseline specification that includes debt.

Figure 4 Responses to a typical Monetary Policy Shock.



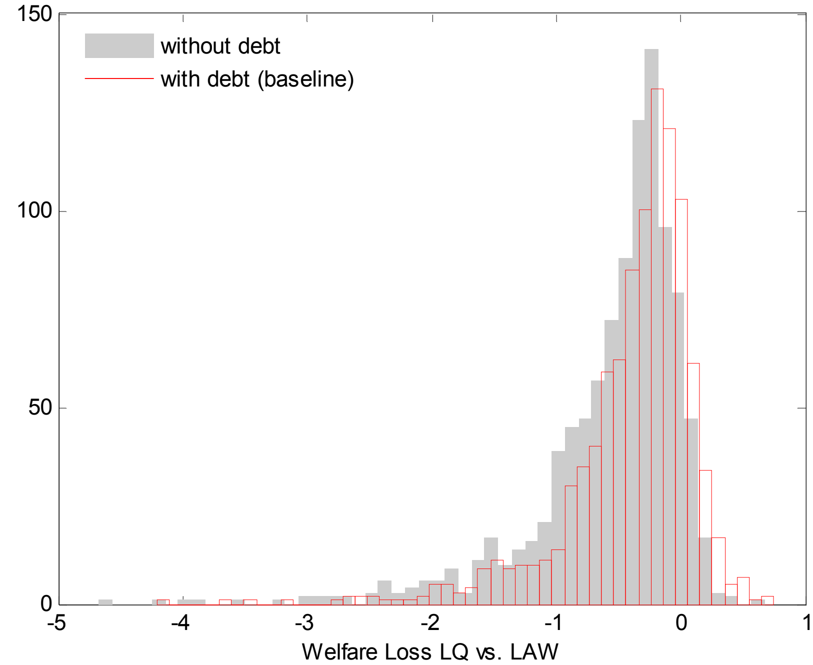
Note: BVAR impulse response function to a 1 standard deviation monetary policy shock under the baseline specification.

Figure 5 Historical Decomposition



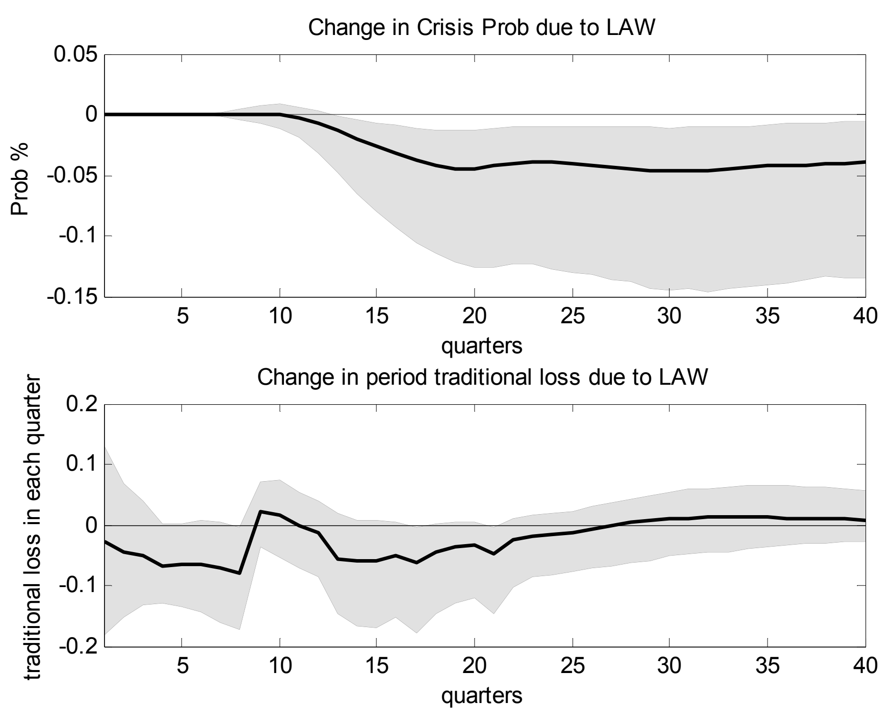
Note: Black solid lines are actual data, red solid line is the contribution of BVAR internal dynamics, and dashed blue lines are the contributions of the set of shocks described on the Y-axis label.

Figure 6 Evaluating the Policy Tradeoffs: Baseline case.



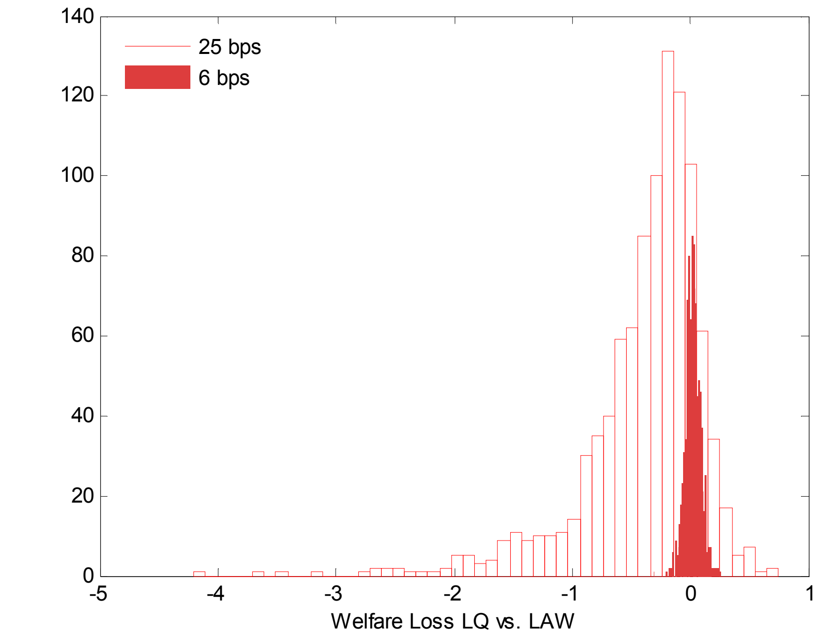
Note: Histograms represent the distribution of loss differentials based on 10000 draws from the BVAR and panel regression distributions. The two histograms compare the specification with and without debt.

Figure 7 Evaluating the Policy Tradeoffs: Costs and Benefits



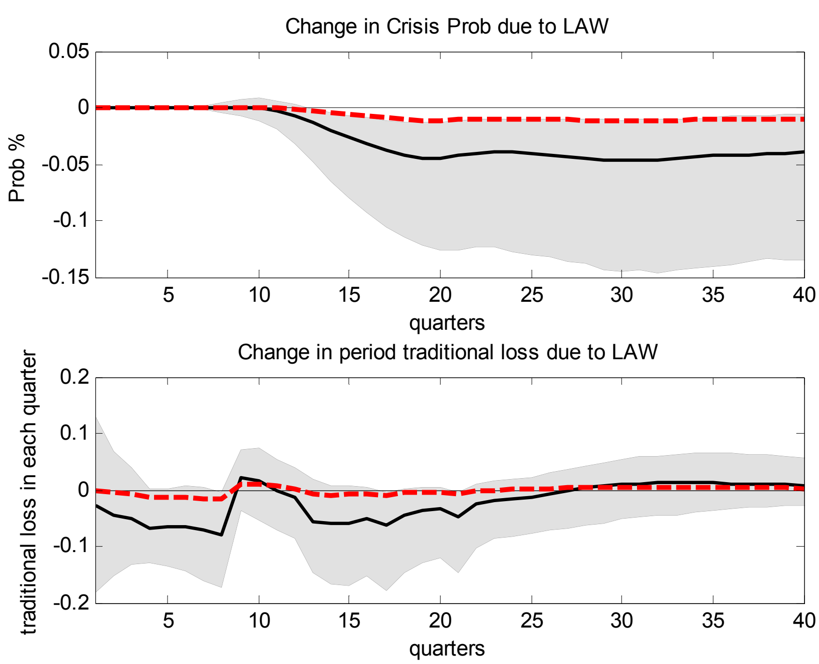
Note: Grey shaded areas represent confidence intervals based on 10000 draws from the BVAR and panel regression distributions.

Figure 8 Evaluating the Policy Tradeoffs: the Best Policy Reaction



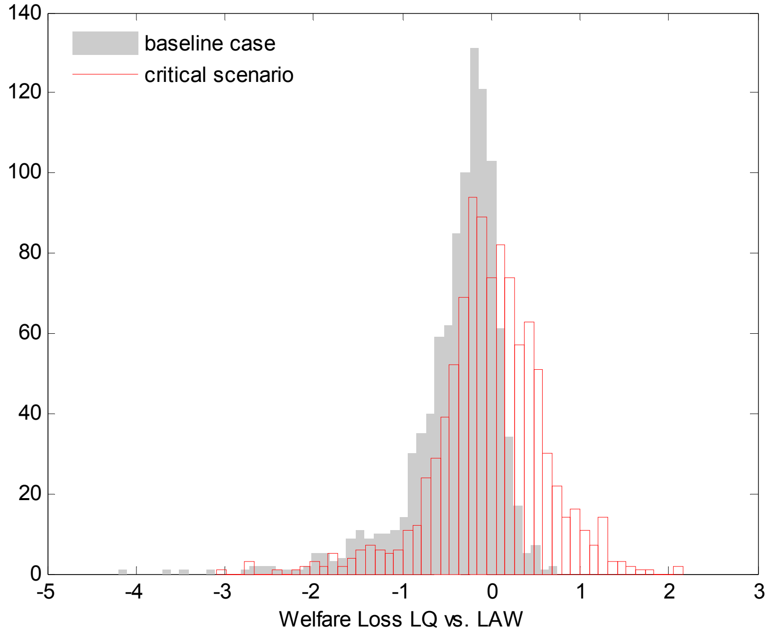
Note: Histograms represent the distribution of loss differentials based on 10000 draws from the BVAR and panel regression distributions. The two histograms compare the specification with the best LAW (6 bps) and the baseline LAW (25 bps).

Figure 9 The Best Policy Reaction: Costs and Benefits



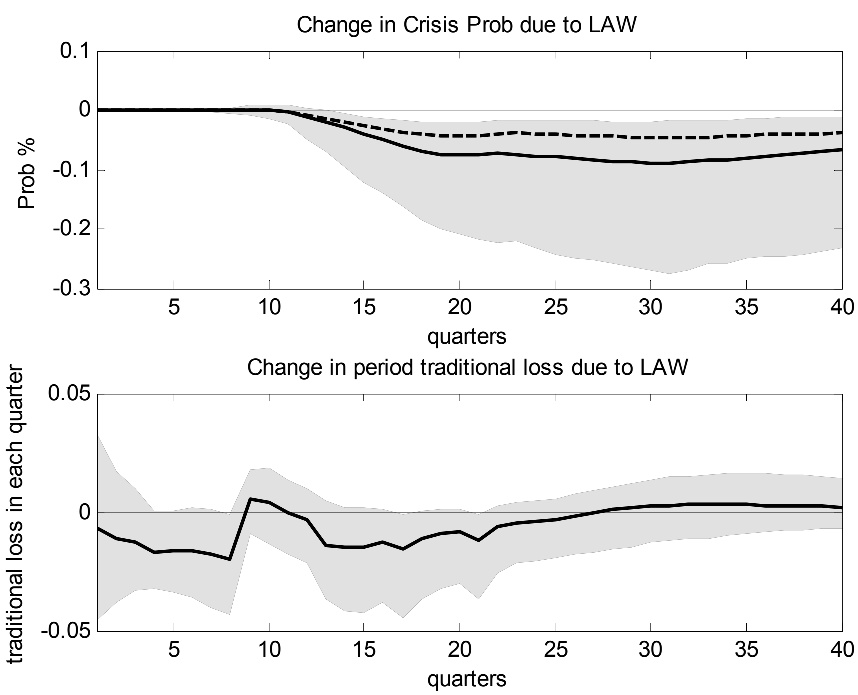
Note: Grey shaded areas represent confidence intervals based on 10000 draws from the BVAR and panel regression distributions. The red-dashed line is the best LAW (6 bps) the black is baseline LAW (25 bps).

Figure 10 Evaluating the Policy Tradeoffs: A Critical Scenario



Note: Histograms represent the distribution of loss differentials based on 10000 draws from the BVAR and panel regression distributions. The two histograms compare the baseline specification (grey) with the severe scenario.

Figure 11 A Critical Scenario: Costs and Benefits



Note: Grey shaded areas represent confidence intervals based on 10000 draws from the BVAR and panel regression distributions. The dashed line represents the severe scenario.