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TABLE OF CONTENTS

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A Review of the Financial Regulatory Framework of Barbados

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Marriage, Employment Participation and Home Production in Search Equilibrium

Abstract

We model a marriage market where singles consider the prospects of employment and income of their potential spouses, and married couples make joint decisions on home production and labor participation. This double interaction between the marriage and labor markets is affected by search frictions in both. We characterize the job search strategies of different couples; equal individuals have different behaviors depending on their spouses. When the search for mates is easy, people marry others with very similar productivity, and both spouses have the same behavior in the labor market. This natural outcome is socially inefficient as it takes some high productivity people off the labor market and viceversa. It also expands income distribution. Some empirical findings in the labor literature are supported theoretically here.

Keywordds: labor markets, marriage markets, employment, home production, equilibrum.

JEL classification: D83, J12, J21.

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1. INTRODUCTION

In any labor market, there is heterogeneity in workers' wages and labor participation rates. Part of it is explained, of course, by differences in productivity: more productive individuals are likelier to pursue work, and to receive a better wage. But, in general, other circumstances may also matter. In particular, the employment status, prospects and wages of one's spouse may affect whether one seeks work, as one shares income and efforts toward home production with that spouse. Married to a high earner, one is likelier to engage in home production, or to be more selective about which jobs to accept. Interestingly, since a person can get clear indications about a marital partner's earning potential while pondering the possibility of marriage, then not only their career is affected by the productive features of their spouse, but their choice of spouse is also affected by their potential careers.

In this paper, we develop a model where agents go first to a marital market and then a labor market. Agents choose their spouses taking into account their expected earnings, and once married the couple makes joint decisions about job search. Hence, the two-directional interaction described above is brought forward. Furthermore, spouses can collaborate not only by working and sharing their income, but by specializing, one in market work, and the other in home production.

We find that in equilibrium, across the space of all possible couples, each pair of spouses has a unique optimal strategy of labor search. There is a positive correlation in earning potentials among spouses. When frictions in the marriage market are small, this correlation is very tight. Couples where both spouses have very similar productivity also have symmetric (within the couple) labor search strategies. Very heterogeneous couples behave asymmetrically. In equilibrium, the population is divided in four classes: spouses with a similar (and high) productivity will constitute a high class where both will always stay in the job market, eventually sacrificing home production completely. If their productivity is similar

but lower, they will choose to take turns to work, and at most generate one income. Other more heterogeneous couples will display strategies where the more productive member is always in the market, and the less productive one stays at home always, or almost always.

Theoretically, our paper contributes to the growing literature that studies the interaction between the marriage and labor markets. We expand on Violante et al. (2012), who show how reservation wages are affected by marital status and joint search. Jaquemet and Robin (2013) study individual labor supply with a frictional marriage market. Bonilla and Kiraly (2013) study how the marriage wage premium arises as an equilibrium outcome in a model with frictional labor and marriage markets. Bonilla et al. (2015) study the link between marriage and beauty wage premia in search equilibrium. We add to this literature as our main purpose is to study the consequences of the link between search for a partner and the facts that participation in the labor market is optional and consumption is, at least partially, a public good.

Empirically, the main contribution of the paper is to explain many previously documented facts from a coherent theoretical framework. Our results reflect Schwartz (2010) who convincingly document that as the search technology has improved, the positive correlation in earning potential among spouses has increased, raising overall income inequality. This increased symmetry in the human capital that the spouses bring into the household reflects an increasing similarity in their inputs and home production hours, as has been shown as far back as Cancian et al. (1993). Schwartz and Mare (2005) analyzes the data and reaches conclusions about the assortative nature of spouse choices, and about the implicit participation decisions, that interestingly fit our main theoretical results. We also get a theoretical explanation for Powell (1997) and Lovász and Szabó-Morvai (2014), who find a positive effect of improved child care provision on female labor supply.

We describe the environment in Section 2, and derive the equilibrium in Section 3. We conclude in Section 4.

2. THE ENVIRONMENT

Time is continuous and continues forever. The population is a continuum of measure Ω_w of infinitely lived women, and another of measure Ω_m of infinitely lived men. Men and women discount future consumption at rate *r*. Each agent is characterized by an observable productivity $p \in \left[\underline{p}, \overline{p}\right]$, taken from the distribution function $F_m(p)$ in the case of men and $F_m(\overline{p})$ in the case of women.

When young, agents first enter a marriage market, where they can search (at a minimal but positive search cost) and encounter members of the opposite sex. For two people to be able to marry they require to be compatible (that is, all aspects of the relationship besides work and income, like attraction, personality, etc.), and not all potential couples are such. We assume that compatibility is a binary characteristic of the couple rather than the individual, uncorrelated with productivity, and not a matter of degree (in other words, if I like you then you like me, and while we could both also like others out there, we would not like them more or less). These meetings between men and women emerge through a Poisson process. For a searching man, compatible women are encountered with an arrival rate $\mu_m = \mu\Omega_w$, and women find compatible men with arrival rate $\mu_w = \mu\Omega_m$.

Upon meeting a potential compatible candidate of the opposite sex, agents also observe their productivity, and they then decide whether to enter a permanent monogamous relationship, which emerges if doing so is strictly mutually agreeable; otherwise, they keep searching for another spouse.[1] We also

[1] The case of unobservable productivity could be interesting, but is not central to the main point of the paper. In addition, this has been addressed in the literature on frictional labor and marriage markets (see for example Boulier and Rosenzweig, 1984; Masters, 2008, or Brien et al., 2006). The most obvious consequence of introducing such consideration is that, in some of the couples, the partners realize ex post that they are not mutually desirable. This would shift the attention to the possibility of divorce, which is not the main concern of the paper. This would require to model in much more detail the process by which information is revealed.

assume that agents can only entertain one suitor at a time, and need to give up a match in order to encounter other matches. When a couple marries, two clones of the newlyweds take their place in the marriage market.

Only once they have married do agents enter the labor market. When searching, jobs are found at another Poisson process, with arrival rate λ. Jobs pay as wages the worker's marginal productivity, and are *indivisible* – or exclusively full-time – employment, in the sense that the number of hours worked is not variable.[2] With arrival rate $\delta > 0$, the job exogenously ends.

Spouses share income and home production; once married, preferences correspond to the couple, not the individual spouses. The value of home production includes two components. The first one (denoted h) is independent of couple's income and is enjoyed when at least one of the partner's is unemployed. The second component increases with income with a marginal effect denoted α (that, for instance, enables to acquire household goods that complement home work or enhance its enjoyment), but requires that at least one member of the couple is not working (to produce that home work). A second unemployed member of the family would be a waste, generating no income and adding nothing to the value of home production. Hence, instantaneous tow utility is:

$$U = \begin{cases} p + P & \text{both work and earn } p \text{ and } P \\ p + h + \alpha p & \text{if one works for wage } p \text{ and the other} \\ h & \text{does not work neither is employed.} \end{cases}$$

In the appendix we address the link between this indirect utility function and the direct function more commonly used in the literature.

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[2] Here, as in much of the macro literature and also, for instance, in Rogerson and Wallenius (2012), individuals either work full time or not at all. Making the number of hours worked an endogenous variable (as in Rogerson and Wallenius, 2013) will probably not change the general meaning of the main results.

Searching for production opportunities carries a cost ε; we assume $\varepsilon > 0$ but look at the limit case where $\varepsilon \to 0$. This infinitesimal cost implies that agents will search only when they expect a strictly positive surplus from the market.[3]

3. EQUILIBRIUM

Due to the sequential nature of the problem, we can work out the labor market choices and performance of any possible couple (whether in equilibrium such a couple would exist or not). Then, given the benefits obtainable in different matches, we look at the spouse-searching strategies of men and women.

For now, with no loss of generality, we will label H the spouse with a weakly higher productivity and L the other spouse; whether H is the man or the woman will of course vary across couples, and is irrelevant for now. Their productivities will be denoted p_H and $p_L \leq p_H$. The value functions that correspond to their circumstances are denoted V_{HL}, where H (or L) take the value 1 when the spouse H (or L) has a job, and 0 when not. These functions V_{HL} are specific to each couple, as another pair with different productivities would enjoy different returns. Then,

$$
\begin{aligned}
rV_{00} &= h + \phi_0\lambda\left(V_{10} - V_{00}\right) + \phi_1\lambda\left(V_{01} - V_{00}\right) \\
rV_{10} &= \left(1+\alpha\right)p_H + h + \delta\left(V_{00} - V_{10}\right) + \phi_2\lambda\left(V_{11} - V_{10}\right) \\
rV_{01} &= \left(1+\alpha\right)p_L + h + \delta\left(V_{00} - V_{01}\right) + \phi_3\lambda\left(V_{11} - V_{01}\right) \\
rV_{11} &= p_H + p_L + \delta\left(V_{01} + V_{10} - 2V_{11}\right).
\end{aligned}
\qquad (1)
$$

[3] Assuming costly search will keep us from having to analize mixed-strategy equilibria where agents who are indifferent between going to the market or not randomize the decision. Here, if you are indifferent about the outcome of search, you choose not to search, to avoid the cost. Notice we do not need to make the same assumption of costly search for the marriage market. In fact, the proofs below are cleaner when we assume that men or women who are strictly indifferent between accepting or rejecting a particular partner always reject and keep searching, for an alternative the leaves them strictly better off.

The first equation tells us that the flow value of a couple where neither has a job is given by the value of home production (which, when nobody is getting an income, is just h), plus two factors related to their search behavior. First, if H is searching (with probability ϕ_0) the arrival rate λ of production opportunities that deliver the surplus $V_{10} - V_{00}$. Second, if L is searching (with probability ϕ_1), the arrival rate λ times the surplus $V_{01} - V_{00}$. The second equation tells us that a couple where only H works enjoys income p_H, plus the fruits of the home production of L (augmented by the income generated by H, or $h + \alpha p_H$), plus the arrival δ of the destruction of H's job, times the implied net loss $(V_{00} - V_{10})$, plus, if L is searching for a job (with probability ϕ_2), the arrival λ of the surplus $V_{11} - V_{10}$. The other two equations can be understood analogously, given ϕ_3 is the probability H would search for a job when L is working.

For couples to behave optimally, at every chance they only search for a job if it improves their condition, so:

$$\phi_0 = \begin{cases} 1 & \text{if } V_{10} > V_{00} \\ 0 & \text{otherwise} \end{cases}$$

$$\phi_1 = \begin{cases} 1 & \text{if } V_{01} > V_{00} \\ 0 & \text{otherwise} \end{cases}$$

2

$$\phi_2 = \begin{cases} 1 & \text{if } V_{11} > V_{10} \\ 0 & \text{otherwise} \end{cases}$$

$$\phi_3 = \begin{cases} 1 & \text{if } V_{11} > V_{01} \\ 0 & \text{otherwise} \end{cases}$$

Definition 1: For all couples (H, L) an optimal job-search strategy is a combination of values $V = (V_{00}, V_{01}, V_{10}, V_{11})$ and labor search probabilities $\phi = (\phi_0, \phi_1, \phi_2, \phi_3)$ that satisfies the Bellman equations (1) and incentive compatibility conditions (2).

In principle, ϕ could take 16 different values, but the set of possible situations narrows quite a bit thanks to the following:

Lemma 2: In any optimal strategy, *a)* $\phi_0 = 1$, and *b)* $\phi_2 = 1 \Rightarrow \phi_1 = \phi_3 = 1$.

Proof. Recall that there are no mixed strategies so the values $\phi_i \in \{0,1\}$. *a)* Clearly, $\phi_0 = 0$ cannot be an optimal strategy when $\phi_1 = 0$, because the couple can raise their income with no sacrifice in home production if at least one of the members gets a job. On the other hand, $\phi_0 = 0$ while $\phi_1 = 1$ cannot be the optimal strategy since it is dominated by $\phi_0 = 1,\ \phi_1 = 0$. Hence, there are no optimal strategies where $\phi_0 = 0$. *b)* When $\phi_2 = 1$, the lower-productivity spouse searches even though the higher-productivity spouse is employed. Then, the option of gaining p_L is worth giving up $h + \alpha p_H$. Clearly, if this is the case, it is also optimal for *H* to search when only *L* is working since $p_H > p_L$ (the prize is higher) and $h + \alpha p_L < h + \alpha p_H$ (the sacrifice is lower). Hence, $\phi_2 = 1 \Rightarrow \phi_3 = 1$.

If the option of gaining p_L (the same prize) is worth giving up $h + \alpha p_H$ (because $\phi_2 = 1$), then it is also worth giving up just *h*. Hence, $\phi_2 = 1 \Rightarrow \phi_1 = 1$. ■

The lemma indicates that, of the 16 possible combinations of ϕ_i that constitute alternative values for $\phi = (\phi_0, \phi_1, \phi_2, \phi_3)$, the eight that include $\phi_0 = 0$ are not the best strategy for any couple, nor the three that include $\phi_2 = 1$ and either $\phi_1 = 0$ or $\phi_3 = 0$. Of the remaining five options, two [$\phi = (1,0,0,0)$ and $\phi = (1,0,0,1)$] can be collapsed into one –say $\phi = (1,0,0,\cdot)$ since they only differ in ϕ_3 which describes a choice that only happens if the *L* has a job, something that does not emerge on the equilibrium path if $\phi_1 = 0$ and $\phi_2 = 0$. Therefore, there are at most four possible types of optimal strategies, where $\phi = (\phi_0, \phi_1, \phi_2, \phi_3)$ assumes the values (1,0,0, ·), (1,1,0,0), (1,1,0,1) or (1,1,1,1).

The procedure to find out when each of these search strategies is the couple's optimal behavior is very simple: Assume one of the four candidate values of ϕ and substitute it in l; then, solve for V_{HL}, and finally verify the parameter combinations for which 2 hold for that candidate ϕ, given those solutions for V_{HL}.

Let's analyze first the strategy (1,1,1,1) where both spouses are always on the job market –either working or searching for work. This strategy leads to families that (in their preferred state) generate two incomes but no home production. Substituting $\phi = (1,1,1,1)$ in l and solving for V_{HL} yields:

$$\Gamma V_{00} = \lambda\left[r(1+\alpha)+2(\delta+\alpha\delta+\lambda)\right](p_H+p_L) \\ +2\delta\left(r^2+3r(\lambda+\delta)+2\delta(\delta+2\lambda)\right)h$$

$$\Gamma V_{10} = r\left[(1+\alpha)r+\left(2(\alpha+1)\delta+(2\alpha+3)\lambda\right)\right]p_H \\ +\lambda\left(2(\alpha\delta+\delta+\lambda)+r\right)(p_H+p_L) \\ +(2\delta+r)(\delta+2\lambda+r)h$$

$$\Gamma V_{01} = \left[(\alpha+1)r^2+r\left(2(\alpha+1)\delta+(2\alpha+3)\lambda\right)\right]p_H \\ +\lambda\left(2(\alpha\delta+\delta+\lambda)+r\right)(p_H+p_L) \\ +(2\delta+r)(\delta+2\lambda+r)h$$

$$\Gamma V_{11} = \left[r^2+r\left((2+\alpha)\delta+3\lambda\right)+2\lambda(\delta+\alpha\delta+\lambda)\right](p_H+p_L) \\ +2\delta(r+\delta+2\lambda)h$$

where $\Gamma = r(\delta+\lambda+r)\left(2(\delta+\lambda)+r\right)$.

Although these expressions are messy, they are also straightforward, and one can apply them to derive that

$$V_{01} > V_{00} \leftrightarrow p_L > \frac{\lambda(h+\alpha p_H)}{2(\alpha+1)\delta+(\alpha+2)\lambda+(\alpha+1)r}.$$

Similarly

$$V_{11} > V_{10} \leftrightarrow p_L > \frac{(\delta+2\lambda+r)(h+\alpha p_H)}{(\alpha+2)\delta+2\lambda+r} \equiv g_1(p_H)$$

and

$$V_{11} > V_{01} \leftrightarrow p_L < \frac{\left((\alpha+2)\delta+2\lambda+r\right)p_H-(\delta+2\lambda+r)h}{\alpha(\delta+2\lambda+r)}.$$

A little further exploration confirms that the first constraint is not binding, because it is laxer than the second constraint for all p_H. Furthermore, the second and third conditions coincide on the (p_H, p_L) plane on the 45° line, at the value

$$p_H = p_L = p^* = \frac{(\delta+2\lambda+r)h}{(1-\alpha)r+2\left((1-\alpha)\lambda+\delta\right)}.$$

For $p_H < p^*$, the two conditions cannot be satisfied jointly. For $p_H \geq p^*$, the third constraint is redundant with $p_L \leq p_H$. Hence, the strategy $\phi = (1,1,1,1)$ is only the optimal job-strategies for couples where $p_H > p^*$ and $p_L > g_1(p_H)$. In other words, this is the behavior in couples where both spouses have similar (and high) productivity.

Analogous derivations can be obtained to characterize for which couples is each of our remaining options of ϕ the optimal job-search strategy. This analysis is presented in the Appendix, and its results are summarized in the following:

Proposition 3. For all possible couples $(p_H, p_L) \in \left[\underline{p}, \overline{p}\right] \times \left[\underline{p}, p_H\right], \exists! \phi = (\phi_0, \phi_1, \phi_2, \phi_3)$ that is optimal, In particular, there are values $p^*, p^o < p^*$ and (linear, increasing) functions $g_i(p_H)$, $i \in \{1,\ldots,4\}$ such that the optimal job-search strategy is

a) $\phi = (1,1,1,1)$ if $p_H > p^*$ and $p_L > g_1(p_H)$.

b) $\phi = (1,1,0,0)$ if $p^o < p_H \leq p^*$ and $p_L > g_3(p_H)$ or if $p_H \leq p^o$ and $p_L > g_2(p_H)$.

c) $\phi = (1,1,0,1)$ if $p_H > p^*$ and $p_L \in \left(g_4(p_H), g_1(p_H)\right]$, or if $p_H \in \left(p^o, p^*\right]$ and $p_L \in \left(g_4(p_H), g_3(p_H)\right]$.

d) $\phi = (1,0,0,\cdot)$ if $p_H \leq p^o$ and $p_L \leq g_2(p_H)$ or if $p_H > p^o$ and $p_L \leq g_4(p_H)$.

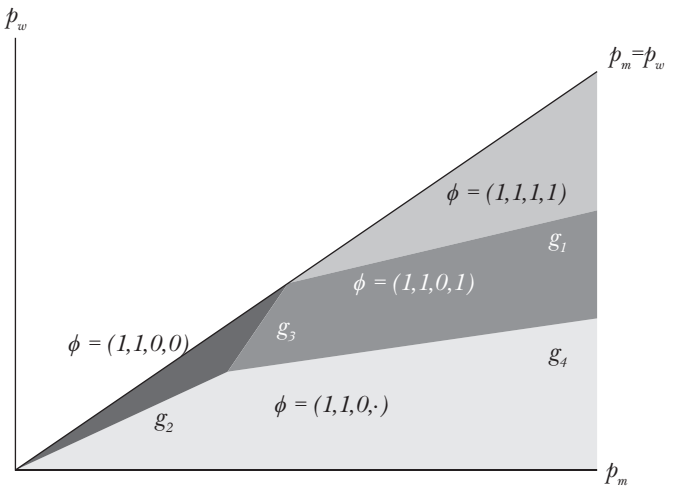
Figure 1 illustrates these results.

Lemma 4. A couples utility is an increasing function of the productivity of each of its members. That is, $V_{0,0}\left(p_H = \max\{p,\pi\}, p_L = \min\{p,\pi\}\right)$ is a weakly increasing, piecewise linear, weakly convex function of p, given π with slope 0 at $p = 0$.

Proof. Let $\pi < p^o$. For $p \sim \underline{p}$, $\partial V_{0,0}\left(p_H = \max\{p,\pi\}, p_L = \min\{p,\pi\}\right) / \partial p = \partial V_{00}^{1000} / \partial p_L = 0$. For $p > g_2(\pi)$ that derivative becomes $\partial V_{00}^{1100} / \partial p_L > 0$, then for $p > \pi$ it is $\partial V_{00}^{1100} / \partial p_H = \partial V_{00}^{1100} / \partial p_L$, then for $p > g_2^{-1}(\pi)$ it is $\partial V_{00}^{1000} / \partial p_H > \partial V_{00}^{1100} / \partial p_H$. All these derivatives are non-negative and constant, and each is larger than the previous one.

Figure 1

OPTIMAL STRATEGIES FOR COUPLES



To verify the same for $\pi \in \left[p^o, p^* \right]$, simply it is a matter of verifying that $\partial V_{00}^{1101} / \partial p_H > \partial V_{00}^{1100} / \partial p_H = \partial V_{00}^{1100} / \partial p_L > \partial V_{00}^{1101} / \partial p_L > \partial V_{00}^{1000} / \partial p_L$, the appropriate values for $\partial V_{0,0} \left(p_H = \max\{p, \pi\}, p_L = \min\{p, \pi\} \right) / \partial p$ as p moves from $\left[\underline{p}, g_4(\pi) \right]$ to $\left[g_4(\pi), g_3(\pi) \right]$ to $\left[g_3(\pi), \pi \right]$ to $\left[\pi, g_3^{-1}(\pi) \right]$ to $\left[g_3^{-1}(\pi), \overline{p} \right]$. Finally, to check the case where $\pi > p^*$, verify $\partial V_{00}^{1101} / \partial p_H > \partial V_{00}^{1111} / \partial p_H = \partial V_{00}^{1111} / \partial p_L > \partial V_{00}^{1101} / \partial p_L > \partial V_{00}^{1000} / \partial p_L$, which in turn corresponds to $\partial V_{0,0} \left(p_H = \max\{p, \pi\}, p_L = \min\{p, \pi\} \right) / \partial p$ as p moves from $\left[\underline{p}, g_4(\pi) \right]$ to $\left[g_4(\pi), g_1(\pi) \right]$ to $\left[g_1(\pi), \pi \right]$ to $\left[\pi, g_1^{-1}(\pi) \right]$ to $\left[g_1^{-1}(\pi), \overline{p} \right]$. ■

Notice we find that symmetric couples have symmetric strategies, and viceversa, in the sense that when the difference in productivity between husband and wife is small, the optimal job search behavior is the same for both.

Notice, for instance, the two regions adjacent to the 45° line, where $p_L \sim p_H$. At the top, a marriage of two similarly productivity people keeps them in the labor market all the time. At the bottom, a marriage of similarly (low) productivity people keeps one of them – does not matter which – at home; when both are unemployed, both search, and when either one finds a job, the other one stops searching. Meanwhile, in the other regions, and especially in the region below where p_L is very low, the differences between the spouses are large, and their behavior is asymmetric. For instance, in the $\phi = (1,0,0,\cdot)$ region, one spouse is always in the market and the other is always at home.

Our results reflect the pattern identified in Powell (1997) and Lovász and Szabó-Morvai (2014) who find that more accessible child care provision, by lowering the opportunity cost of home production, increases female labor supply. Think for example of decrease in the value of home production. In this case $g_3(p_H)$ shifts to the left, while $g_4(p_H)$, $g_1(p_H)$ shift down and both p_0 and p^* decrease. Further, the decrease in $g_1(p_H)$ is higher than that of $g_4(p_H)$. This translates into the following qualitative results: The area $\phi = (1,1,0,0)$ and $\phi = (1,0,0,\cdot)$ both decrease, reflecting that now fewer marriages will be such that one of the partners (the L in area $\phi = (1,0,0,\cdot)$) ends up not participating in the labor market. The area $\phi = (1,1,0,1)$ also decreases, but it does so to accommodate the expansion of area $\phi = (1,1,1,1)$. Once again, this means less partnership in which the L stops participating in the labor market, and more marriages in which both partners remain in the labor market forever. A similar pattern obtains as one analyzes a decrease in α (brought about for example by an increase in the social provision of leisure opportunities).

As frictions disappear in the labor market $(\lambda \to 0)$, we find that $p^o = p^* = \frac{h}{1-\alpha}$, $g_4(p_H) = g_1(p_H) = h + \alpha p_H$, and $g_2(p_H) = p_H$. This means that areas $\phi = (1,1,0,0)$ and $\phi = (1,1,0,1)$ disappear. In other words, the only couples that may arise are either those where both spouses work or those were L never

works; especially the latter are very frequent for extremely high values of λ, since $\frac{\partial p^*}{\partial \lambda} > 0$, $\frac{\partial g_1(p_H)}{\partial \lambda} > 0$.

The results also match the findings in Schwartz (2010) that improvements in the partners' search technology increases the association between spouses' earnings, thus raising inequality as marriages increasingly consist of two high-earning or two low-earning partners.[4] In our model, the individual behavior of different types of couples may augment this inequality across society. See, for example, the contrast between a couple applying $\phi = (1,1,1,1)$ and another choosing $\phi = (1,1,0,0)$. Individually, each member in the first couple is more productive than each member in the second. Collectively, when both couples reach their desired state the former has twice the number of employed people than the latter, the differences in income become much larger. After discussing the equilibrium in the marriage market below, we address the links between family income distribution and efficiency in our equilibria.

What about the marriage market? Compatible, unemployed single people encounter each other at rate $\mu_k, k = m, w$. Denote $\hat{V}_m(p)$ the value for single men with productivity p of searching in the marriage market. Obviously, for this man there is a reservation value, call it $R_m(p)$, such that he is not willing to marry a woman, even if she is compatible, with productivity lower than $R_m(p)$. For a woman with productivity p we can define $\hat{V}_m(p)$ analogously.

Then,

[4] Please note, in class formation as in Burdett and Coles (2006), the correlation in the productivity of those who marry arises without assuming any correlation in the incomes of those who meet. If one were to assume a matching process in which people with similar income are more likely to meet, this would only strengthen those results.

$$r\hat{V}_m(p) = \mu_m \int_{R_m(p)}^{R_w^{-1}(p)} V_{0,0}\left(p_H = \max\{p,\pi\}, p_L = \min\{p,\pi\}\right) dF_w(\pi),$$

3

$$r\hat{V}_w(p) = \mu_w \int_{R_w(p)}^{R_m^{-1}(p)} V_{0,0}\left(p_H = \max\{p,\pi\}, p_L = \min\{p,\pi\}\right) dF_m(\pi).$$

The bounds in the integral simply imply that a single person of gender k with productivity p would not accept a marriage proposal from somebody with $\pi \le R(p)$, nor get one from somebody with $\pi \ge R_{-k}^{-1}(p)$.

Definition 5. Equilibrium in the marriage market is a pair of value function $\hat{V}_m(p), \hat{V}_w(p)$ and reservation strategies $R_m(p), R_w(p)$ such that 3 holds for all p.

Of course, because all agents would rank any two (suitable) marriage candidates in the same order, we know from Burdett and Coles (2006) that, in any equilibrium for the marriage market the population will be assorted in classes, where the men in the top class marry women of the top class, men in the second class marry women in the second class, and so on, with the possibility that, for some parameter values, some men or some women with very low productivity may never find someone who would take them.[5]

Lemma 6 (Burdett-Coles). There is a unique equilibrium of a marriage market, which takes the form of a partition of $\left[\underline{p}, \overline{p}\right]$ into sets S_i^m for the population of men, and S_i^w for the population of women where $S_1^k = \left[R_k(\overline{p}), \overline{p}\right]$, $\ldots S_i^k = \left[R_k o^i R_k(\overline{p}), R_k o^{i-1} R_k(\overline{p})\right]$, $k \in \{w,m\}$, where all agents of gender k with productivity $p \in S_i^k$ always marry the first compatible member of S_i^{-k} that they encounter.

If the number of sets S_i^m for men is n then the number of sets S_i^n for women will be $n-1$ (the least productive men never marry),

[5] It is an unfortunate feature of the model that these men or women that never marry also never work. This comes from our choice of sequence (first the marriage market, only then the labor market). We have explored the alternative where agents enter both markets simultaneously, but in this case the number of states to keep track of expands significantly, and the flavor of the results does not change. Hence, we opted for simplicity in this regard.

n (everybody marries eventually) or $n+1$ (the least productive women never marry).

If μ/r is very low, $n=1$. Also, n increases with μ/r and $n \to \infty$ as $\mu/r \to \infty$.

The link between inequality across agents and inequality across couples is behind an inefficiency in equilibrium that we derive and that reduces welfare. In this regard, please note that as frictions disappear in the marriage market, then everybody marries her or his equal and all couples lie along the 45° line. In couples less productive than p^* this means that one relatively unproductive worker, but slightly more productive than their spouse, remains in the labor market; couples more productive than p^* are left –by choice– without the benefits of home production. Without a subsequent labor market, this would be welfare enhancing. In our framework, this is not necessarily the case. A social planner would try to generate a negative correlation between the productivity of spouses, to ensure that the less productive workers in society are as often as possible the less productive worker in their marriages, hence facilitating that they stay at home and specialize in home production, while the most productive workers in society are also the most productive workers in their couple, facilitating that they stay in the market. The equilibrium, by generating a positive correlation across spouses productivities, would keep out of the labor market some highly productive agents (because they married even more productive spouses), and would keep in the labor market some very unproductive agent (because they married even less productive spouses).[6]

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[6] A simple example is one where the population is divided in two halfs, with productivities p_1 and p_2, where p_2/p_1 is a very high number. If μ and α are both high enough, in equilibrium the p_1 agents only marry each other, the p_2 agents only marry each other, and the labor force will be composed of half the population, of which again half would be p_1 and half would be p_2. In this case, the more productive half of society would enjoy utility $(1+\alpha)p_2$ and the other half would enjoy $(1+\alpha)p_1$. A social planner would prefer it if each p_1 married a p_2 (and viceversa),

Corollary 7. The assortative nature of the marriage market equilibrium leads to an inefficient allocation in the labor market. In particular, some relatively productive individuals will stay at home if their spouse is even more productive, and some relatively unproductive individuals will stay in the labor market if their spouse is even less productive. An efficient outcome would require a negative correlation between the spouses productivities, so for every very productive man or woman there would be incentives to be always in the job market, married to a very unproductive spouse that stays always at home.

Notice that one's productivity at home is proportional to the productivity at work of one's spouse.

Corollary 8. If men and women are very similar (that is, both genders have similar population sizes and similar distributions F_k), then for large levels of μ / r , almost all agents have very similar productivity to their spouse, and thus most couples belong to the sets where, in equilibrium, ϕ = (1, 1, 1, 1) or ϕ = (1, 1, 0, 0). As we consider lower levels of μ / r , and the sets S_i are less numerous but larger (or, alternatively, if we allow for disparities between the population of men and the population of women) there are sometimes bigger productivity differences across spouses, and an increasing fraction of the couples population share the home burdens asymmetrically $\phi = (1,1,0,1)$ and $\phi = (1,0,0,\cdot)$.

Corollary 9. The standard deviation of household per-member incomes is larger than the standard deviation of individual productivities, both because highly productive individuals marry each other, and because those couples have a higher average participation rate than other couples.

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ensuring in that case that all the p_1 agents stay at home and all the p_2 agents work, which yields the higher utility $(1+\alpha)p_2$ for all agents. Hence, the same sorting mechanism that makes income distribution more skewed among couples than among individuals also leads to a loss of expected utility for all agents. Also, efficient sorting is likelier to emerge when productivity across agents is less variable.

Corollary 10. If there are asymmetries in the distribution of productivities of men and women, $F_w \neq F_m$ (say, because the here-unmodelled opportunities for education are not equal), in general the less productive gender will have a lower participation rate.

Corollary 11. If there are differences in population size between men and women, $\Omega_m \neq \Omega_w$, everything else being symmetric, the gender with the higher population will be less selective about marriage partners (have a lower $R_k(p)$), have a higher average labor-participation rate (since many of them will marry partners of the opposite sex that are less productive, since they are less selective), marry faster, and be likelier to have a low-class of individuals that never marry.

4. CONCLUSIONS

We have developed a model where the choice of marriage partner is endogenous, and once the couple is formed, it jointly decides its labor supply and home production. We find that the equilibrium involves different labor search strategies for different couples, and that often married agents – even the more productive spouse within the household, or somebody who has relatively high productivity among the population – stay at home. Couples of spouses with similar productivities to each other tend to choose strategies where both spouses do the same thing, while asymmetric couples tend to have asymmetric strategies. The latter kinds of couples tend, in equilibrium, to be less abundant (due to the assortative nature of equilibria), and more so as the technology for meeting potential spouses improves.

We find that the results we underscore in the corollaries in Section 3 match a number of findings in the empirical literature. Besides the facts mentioned in the Introduction, the findings about who marries whom tend to reconcile the results in Schwartz and Mare (2005), but the implications about income inequality do not necessarily follow, since in any equilibria where the two spouses in the couple behave symmetrically,

in about half the households at any given time the less productive spouse is in the market and the more productive one stays at home. This means the income distribution among households may be more unequal than the productivity distribution among individuals. Thus, the results in Cancian et al. (1993) are also consistent with our theoretical results.

5. APPENDIX

5.1 Proof of Proposition 1

We apply the same procedure that we used in the text for the strategy $\phi=(1,1,1,1)$ now to the other three candidate strategies (not ruled out by Lemma 1): $\phi=(1,1,0,0)$, $\phi=(1,1,0,1)$, and $\phi=(1,0,0,\cdot)$.

Consider first $\phi=(1,1,0,0)$. In this case, the value functions become

$$V_{00}=\frac{(1+\alpha)\lambda(p_L+p_H)+(r+2\lambda+\delta)h}{r(\delta+2\lambda+r)},$$

$$V_{01}=\frac{\delta\lambda(1+\alpha)(p_L+p_H)+(1+\alpha)r(\delta+2\lambda+r)p_L+(r+\delta)(\delta+2\lambda+r)h}{r(\delta+r)(\delta+2\lambda+r)},$$

$$V_{10}=\frac{\delta\lambda(1+\alpha)(p_L+p_H)+(1+\alpha)r(\delta+2\lambda+r)p_H+(r+\delta)(\delta+2\lambda+r)h}{r(\delta+r)(\delta+2\lambda+r)},$$

$$V_{11}=\frac{\left[r^2+2(1+\alpha)\delta\lambda+r\left(2\lambda+(2+\alpha)\delta\right)\right](p_L+p_H)+2\delta(\delta+2\lambda+r)h}{r(2\delta+r)(\delta+2\lambda+r)},$$

and the incentive compatibility conditions require only $V_{01}>V_{00}$ and $V_{10}\geq V_{11}$, since the latter makes $V_{01}\geq V_{11}$ redundant. This narrows to

$$p_L > g_2(p_H)\equiv\frac{\lambda p_H}{\delta+\lambda+r}$$

$$p_L \geq g_3(p_H)$$

$$\equiv\frac{\left(\left[r^2+r\left(\alpha\delta+3\delta+2\lambda\right)+\delta\left(\alpha\delta+2\delta+\alpha\lambda+3\lambda\right)\right]\right)p_H-(\delta+r)(\delta+2\lambda+r)h}{\delta\alpha(\delta+3\lambda)+\delta\lambda+\alpha r^2+2\alpha r(\delta+\lambda)},$$

where we know that $g_3(p_H) < p_H$ only when $p_H < p^*$, as defined above, and that $g_2 \geq g_3$ if

$$p_H < p^\circ \equiv \frac{h(\delta+\lambda+r)}{\delta(\alpha+2)+(1-\alpha)\lambda+r}.$$

Therefore, the region where $\phi = (1,1,0,0)$ is an optimal strategy, is the one above g_2 for $p_H < p^\circ$, and above g_3 for $p_H \in [p^\circ, p^*]$. Consider now the job search strategy $\phi = (1,0,0,\cdot)$. Under this strategy,

$$V_{00} = \frac{\lambda(1+\alpha)p_H + (\delta+\lambda+r)h}{r(\delta+\lambda+r)}$$

$$V_{01} = \frac{\lambda\delta(1+\alpha)p_H + r(1+\alpha)(\delta+\lambda+r)p_L + (r+\delta)(\delta+\lambda+r)h}{r(\delta+r)(\delta+\lambda+r)}$$

$$V_{10} = \frac{(1+\alpha)(\lambda+r)p_H + (\delta+\lambda+r)h}{r(\delta+\lambda+r)}$$

$$V_{11} = -\frac{r(\delta+\lambda+r)(r+2\delta+\alpha\delta)(p_L+p_H) + 2(1+\alpha)\delta^2\lambda p_H + 2\delta(\delta+r)(\delta+\lambda+r)h}{r(\delta+\lambda+r)(\delta+r)(2\delta+r)},$$

and optimality requires $V_{01} \leq V_{00}$ and $V_{11} \leq V_{10}$. The former translates into $p_L \leq g_2(p_H)$; the latter translates into

$$p_L \leq g_4(p_H) \equiv \frac{\lambda(h+\alpha p_H)}{(r+2\delta)(1+\alpha)+\lambda}.$$

As it turns out, g_2 is the binding upper bound when $p_H \leq p^\circ$, and viceversa.

To conclude, consider now the job-search strategy $\phi = (1,1,0,1)$. The value functions are straightforward to obtain yet rather messy, so we skip directly to the incentive compatibility conditions, which require simply $V_{10} \geq V_{11} > V_{01} > V_{00}$.

From the solutions of the value functions we derive that $V_{01} > V_{00}$ corresponds to $p_L > g_4(p_H)$. Meanwhile, $V_{10} \geq V_{11}$ holds if and only

if $p_L \leq g_1(p_H)$, and $V_{11} > V_{01}$ if and only if $p_L < g_3(p_H)$. Since we know that the former is the binding constraint if $p_H > p^*$, and viceversa, we conclude that the couples for whom $\phi = (1,1,0,1)$ is the best job-search strategy are those that satisfy

$p_H > p^*$ and $g_1(p_H) \geq p_L \geq g_4(p_H)$ or

$p^* \geq p_H \geq p^\circ$ and $g_3(p_H) \geq p_L \geq g_4(p_H)$.

5.2 Link to a Direct Utility Function

Here we address the link between the indirect utility function we use, and the direct function more commonly used in the literature, with features that include a fixed amount of available time that can be used either to work, as an input in home production, or to consume leisure; and include a home production function that uses time from the individuals and goods produced as inputs.

In the model, individuals either participate in the labor market full time or not at all. Income derived from the labor market for a couple, the independent variable in this utility function, has a domain that is not a dense interval in the real line, but a set of four discrete points (the income he can get, the income she can get, the income can get together, and 0 –the income that they get if neither works). Label these four points to be $y_0 = 0$, $y_1 = p_L$, $y_2 = p_H$ and $y_3 = p_L + p_H$, and consider the choice of how to allocate the resulting non-working time between leisure and home production. The option of allocating 0 hours to home production yields utility u_i to a couple with market income y_i, and the optimal allocation between leisure and home production yields utility $v_i \geq u_i \geq y_i$. Our only other restriction relative to some papers in the literature is that we assume that an agent working full time in the market cannot work at all at home. Hence, $h \equiv v_0$ follows with no loss of generality, $v_3 = y_3$ follows from this restriction, and we can define the values α_1 and α_2 by the equation $v_i = y_i(1+\alpha_i) + v_0$.

Consider a general utility $u(l, c, d)$ as a function of leisure l, consumption of market goods c, and consumption of domestic

goods d. Commonly, we assume that d is an increasing function of homework hours $d = f_1(h_h)$, c an increasing function of market work hours and productivity $c = pf_2(h_m)$, and l is the time left after working in both, $l = H - h_h - h_m$. We are imposing, as we said above, restrictions on this general problem. The first is that $h_m \in \{0, H\}$, which implies that for each spouse there is a binary choice: either $h_h = 0$, $h_m = H$ and contribute $p_i f_2(H)$ to total c, or $h_m = 0$ and contribute 0 to total c. There are four types of household, defined by this binary choice. In type 0, $h_{Lm} = h_{Hm} = 0$, $c = 0$, and the couple maximizes $u(l, 0, f_1(2H-l))$, choosing an optional value l_0 that satisfies the first order condition $u_1(\,) = u_3(\,)f_1(\,)$, that yields utility $u_0 = u(l_0, 0, f_1(2H-l_0))$. In type 1, where L works, $h_{Lm} = H$, $h_{Hm} = 0$, $c = p_L \Gamma$ (where $\Gamma = f_2(H)$ is a constant), and couples maximize $u(l, \Gamma p_L, f_1(H-l))$, again choosing an optimal value l_1 that satisfies analogous FOCs and implicitly yields utility $u_1 = u(l, \Gamma p_L, f_1(H-l_1))$. In type 2, where H works, obviously the couple is optimizing $u(l, \Gamma p_H, f_1(H-l))$ and deriving $u_2 = u(l_2, \Gamma p_H, f_1(H-l_2))$. In type 3, where both spouses work, $h_{Lm} = h_{Hm} = H$, $c = (p_H + p_L)\,\Gamma$, $l = 0$ and the derived utility is going to be $u_3 = u(0, \Gamma(p_L + p_H), f_1(0))$. At this point, these FOCs and implicit values u_i are obtained with no loss of generality across the set of possible functions $u(l, c, d)$, applying as a unique restriction relative to some literature that $h_m \in \{0, H\}$. It is natural (and again only a normalization) to assume that $f_1(0) = 0$, $u(0,y,0) = y$. Again with no loss of generality define the parameter that we called h in the paper as the value u_0, and derive that $u_3 = (p_L + p_H)\,\Gamma$. The only restriction we are imposing here is that $u(l_1, \Gamma p_L, f_1(H-l_1))/u(H, \Gamma p_L, 0) = u(l_2, \Gamma p_H, f_1(H-l_2))/u(H, \Gamma p_H, 0)$, which is guaranteed, among others, by any u function that his homogeneous in its first and third components.

With this notation, the only three restrictions we are imposing on the most general utility functions common in the literature are: *a)* That individuals either participate in the labor market or not at all. *b)* That individuals who work in the market do not work at home. *c)* That $\alpha_1 = \alpha_2$.

Restriction *a)*, as mentioned before, is something done quite frequently in broader literatures since Hansen (1984), and done

in this literature, for instance, in Rogerson and Wallenius. Restriction *b)* is not too stringent. Only restriction *c)* is a loss of generality relative to the literature, and we do not feel it is big here. Again, in the absence of restriction *a)*, if the range of the possible incomes was an interval of the real line, restriction *c)* would amount to choosing a very specific functional form for utility (one where utility is homogeneous in leisure and home production, including but not limited to Cobb-Douglas). But given the granularity of the range, restriction *c)* is not that stringent. A discrete domain implies that order, not curvature, is the relevant attribute.

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Carlos A. Medel

Inflation Dynamics and the Hybrid New Keynesian Phillips Curve: The Case of Chile

Abstract

It is recognized that the understanding and accurate forecasts of key macroeconomic variables are fundamental for the success of any economic policy. In the case of monetary policy, many efforts have been made toward understanding the relation between past and expected values of inflation, resulting in the so-called hybrid New Keynesian Phillips curve (HNKPC). In this article I investigate to which extent the HNKPC help to explain inflation dynamics as well as its out-of- sample forecast for the case of the Chilean economy. The results show that the forward-looking component is significant and accounts from 1.58 to 0.40 times the lagged inflation coefficient. Also, I find predictive gains close to 45% (respect to a backward-looking specification) and up to 80% (respect to the random walk) when forecasting at 12-months ahead. The output gap building process plays a key role delivering better

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results than similar benchmark. None of the two openness measures used—real exchange rate nor oil price— are significant in the reduced form. A final estimation using the annual variation of a monthly indicator of GDP deliver reasonable forecast accuracy but not as good as the preferred forecast-implied output gap measure.

Keywords: New Keynesian Phillips curve, inflation forecast, out-of-sample comparisons, survey data, real-time dataset.

JEL classification: C22, C53, E31, E37, E47.

1. INTRODUCTION

The aim of this article is to investigate to which extent forward-looking (FL) measures of inflation help to explain inflation dynamics as well as its out-of-sample behavior with a Phillips curve ensemble. This objective is tackled by analyzing the performance of the so-called hybrid New-Keynesian Phillips curve (HNKPC), introduced by Galí and Gertler (1999, GG), using a dataset of the Chilean economy.

It is widely recognized that the understanding and accurate forecasts of key macroeconomic variables are fundamental for the success in almost all economic policies. In the case of monetary policy, inflation forecasts are not useful from a practical but from a theoretical viewpoint also. Many efforts have been made toward understanding the relation between past and expected values of inflation (even going beyond the particular case of inflation; see Elliott, Granger, and Timmermann, 2006, and Clements and Hendry, 2011). The former component of inflation reflects the traditional inertia of price setting, while the latter stands as an ingredient of rational expectations agents' behavior. This corresponds to a confluence of the traditional Muth (1961) argument on asset dynamics but without allowing jumps given inertia modelling (Fuhrer, 2011). The HNKPC offers an amalgamation of these two components by allowing both a Calvo price setting scheme plus a fraction of FL price-setters firms (see Calvo, 1983, and GG).

Suppose a staggered price-setting scheme. Let $1-\theta$ the fraction of firms that change prices at a given period, and $1-\omega$ the fraction of firms that set prices optimally in a FL manner. Hence, current prices constitute a weighted average between backward- (BL) and FL-firms, leading to the HNKPC baseline equation:

$$\pi_t = \lambda x_t + \gamma_b \pi_{t-1} + \gamma_f \mathbb{E}_t\left[\pi^f_{t,t+h}\right] + \varepsilon_t \,, \qquad (1)$$

where π_t is inflation, $\mathbb{E}_t\left[\pi^f_{t,t+h}\right]$ is the inflation expectation at period *f*, measured with a forecast made *h*-step ahead at period *t*, and x_t is a real marginal cost measure. $\left\{\lambda;\gamma_b;\gamma_f;\sigma^2_\varepsilon\right\}$ are parameters to be estimated, and ε_t is a cost-push shock, $\varepsilon_t \sim iid\ N\left(0,\sigma^2_\varepsilon\right)$. This specification constitutes a reduced form of a structural NKPC with $\gamma_f = \beta\theta/\phi$, $\gamma_b = \omega/\phi$, $\lambda = \left[(1-\omega)(1-\theta)(1-\beta\theta)\right]/\phi$ where β is a discount rate, and $\phi = \theta + \omega\left[1-\theta(1-\beta)\right]$. Equation 1 results in a convenient form as it allows many price setting schemes, making possible simple forecasting exercises (as, for instance, that of Jean-Baptiste, 2012).

There is a huge literature concerning a formal theoretical derivation of the HNKPC. Some examples are Smets and Wouters (2003, 2005), Christiano, Eichembaum, and Evans (2005), Erceg and Levin (2003), and Collard and Dellas (2004), among others.

Some other specifications, specially defined for open economies, include different and more complicated output gap definitions or simply more independent variables in Equation 1.[1] Galí and Monacelli (2005) analyze the case of the NKPC in a small open economy using a rich economic model leading to a simple reduced model including domestic inflation and output gap. There is also provided an application to the Canadian case; same as in Kichian and Rumler (2014). In the same

[1] A thorough review in this matter can be found in Corsetti, Dedola, and Leduc (2010).

vein (NKPC in small open economies), Rumler and Valderrama (2010) analyze the case of Austria, Balakrishnan and López-Salido (2002), Batini, Jackson, and Nickell (2005), and Posch and Rumler (2015) of the United Kingdom (UK), Leith and Malley (2007) of G7 countries, Rumler (2007) of Euro Area countries, and Mihailov, Rumler, and Scharler (2011) of some OECD countries. All these articles put a special attention to test the existence of an open economy component and in some cases providing out-of-sample evidence. There is no a unique nor common way on how to include openness in the baseline model. It is expected to differ considerably on the manner how openness is included. But, openness in reduced form equation typically lies within the options of either the output gap or as an independent variable. Obviously, the latter type is easier to handle with forecasting purposes.

Many of the empirical evidence of the HNKPC have been collected for industrialized economies. Some selected examples are Roberts (1997), GG, Galí, Gertler, and López-Salido (2005), Rudd and Whelan (2005), and Brissimis and Magginas (2008) for Unites States (US), Jean-Baptiste (2012) for the UK, McAdam and Willman (2003) for the Euro Area, and Jondeau and Le Bihan (2005) for the UK and major Euro Area countries. The main difference in their methodology concerns inflation expectation proxies, real-time estimates with different data vintages, and the measurement of marginal costs.[2]

A current controversial methodological discussion confronts the results obtained by Rudd and Whelan (2005) in opposition to those of GG. While the former finds that lagged inflation is the major driver of current inflation, the latter states that is the FL component. This bifurcation is due to different

[2] It is worth mentioning that the US economy has richer conclusions on this matter as it has several sources of survey expectations data with a long sample span, as is the case of the Survey of Professional Forecasters (SPF) of the Federal Reserve Bank of Philadelphia, the Livingstone Survey, the Michigan Survey, the Greenbook, Consensus Forecasts, the Congressional Budget Office, and the Real-Time Data Set for Macroeconomists (Croushore and Stark, 2001).

specifications and estimation method assumptions; still an ongoing buoyant discussion. This article follows more closely the GG derivation of the HNKPC, with some minor twists explained later. Closer literature supporting the GG findings and methodology are Galí, Gertler, and López-Salido (2001), Sbordone (2002), Smets and Wouters (2003, 2007), Levin et al. (2005), Rabanal and Rubio (2005), Nason and Smith (2008) –using the SPF expectations for the US economy–, and Henzel and Wollmershauser (2008) –using CESifo World Economic Survey for Italy– among others.[3]

More evidence on the HNKPC is provided by Paloviita and Mayes (2005) for a panel of OECD countries. The authors, by using a real-time database, find an influential role for the expectations; also unveiling the controversial role of the output gap as a measure of marginal costs. Also considering real-time data, Gruen, Robinson, and Stone (2002) and Robinson, Stone, and van Zyl (2003) consider the case of Australia. The issue of real-time datasets has been analyzed thoroughly in Orphanides (2001), Orphanides and van Norden (2002, 2003), and Rünstler (2002). They provide evidence supporting the view that due to different data vintages, estimated coefficients are subject to a substantial data measurement uncertainty.

Canova (2007) analyzes the case for G7 countries using several multivariate economics and statistical-based models. Nunes (2010) analyze the case for United States, whether is allowed rational expectations and expectations coming from a survey. By doing this, the author is able to include different types of firms when setting prices beyond the traditional Calvo setup. Granger and Jeon (2011) reinterpret the original Phillips (1958) article with modern econometric techniques using the original and extended data sample for the UK. This exercise is

[3] There is also literature supporting the Rudd and Whelan (2005) arguments –specially concerning the theoretical derivation of the NKPC– as, for instance, Rudd and Whelan (2007), Agénor and Bayraktar (2010), Mazumder (2010, 2011), Abbas and Sgro (2011), Lawless and Whelan (2011), and Vašíček (2011).

interesting since ease a comparison with all the new elements developed to obtain the GG NKPC.

Some other approaches include that of Carriero (2008) arguing that it is possible to test the NKPC without having to estimate its structural parameters. Using this approach, the author is unable to find a combination of structural parameters coherent with US data. This result suggests that the process of expectations formation does not necessarily obeys entirely to the rational expectations hypothesis. Lanne and Luoto (2013) propose an estimation method based on a univariate noncausal autoregressive model to avoid simultaneity problems when using the GMM estimators. By using this, most of the quarterly US inflation dynamics seems driven by inertia. Some other variations can be found in Smets and Wouters (2002), Matheron and Maury (2004), Batini, Jackson, and Malley (2005), Petrella and Santoro (2012), Malikane and Mokoka (2014), and Posch and Rumler (2015), among others.

Finally, for the case of Chile, little research has been conducted in this matter. Some exceptions are Céspedes, Ochoa, and Soto (2007) and Pincheira and Rubio (2010). The first article derives a NKPC from a structural microfounded model, and analyzes their in-sample ability to explain inflation dynamics. The second article addresses the issue of the weak predictive power of purely BL PC with real-time data. While Céspedes, Ochoa, and Soto (2007) also provide an out-of-sample assessment, it is not the major concern of the authors. Instead, inner motivation of Pincheira and Rubio (2010) –shaping the specification search exercise– is precisely forecast accuracy.

In this article I first estimate an unrestricted version of the HNKPC with Chilean data, to then compare its predictive power with a BL PC and traditional benchmarks predicting at h-months-ahead, $h = \{1; 3; 6; 12\}$. The dataset corresponds to monthly inflation, a monthly index of economic activity, and the expectations of the Chilean Survey of Professional Forecasters (ChSPF). The estimation is made through the generalized method of moments (GMM). As a robustness exercise, I also analyze to what extent traditional openness measures

are allowed in the reduced form of Equation 1. Again, for robustness purposes, I conduct the same estimations with the so-called *core inflation*. A stability analysis is complemented with some recursive estimations to shed some light about (in-sample) parameter uncertainty.

The results show that the FL inflationary component is statistically significant when is included in the specification. In size, accounts from 1.58 to 0.40 times the lagged inflation coefficient. Real-time ChSPF forecasts of output are also useful but as instruments.[4] When considering short-term forecasting, I find predictive gains close to 45% (respect to the BL specification) and up to 80% (respect to the random walk) when forecasting at 12-months-ahead. However, these gains are not statistically significant according to the traditional Giacomini and White (2006; GW) test. In sum, these results should be read carefully and just as a valid benchmark.

The in-sample results for core inflation support the existence of the HNKPC. Nevertheless, predictive results suggest that core could be a process with higher memory. The output gap plays a key role delivering better results than similar benchmark. None of the two openness measures used –real exchange rate nor oil price– deliver significant results in the reduced form. A robustness checking estimation using the annual variation of a monthly indicator of GDP instead of output gap deliver reasonable forecast accuracy but not as good as the preferred forecast-implied output gap measure.

The article proceeds as follows. In Section 2, I detail the econometric procedure, alongside the dataset utilized emphasizing the output gap construction –an unobservable variable. Section 3 presents the empirical results divided in those obtained in-sample and those when predicting both measures of inflation. It is also presented the result of robustness exercises. Finally, Section 4 concludes.

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[4] This finding is in line with those of Orphanides and van Norden (2002, 2005) obtained for the US economy.

2. ECONOMETRIC SETUP

The baseline specification is the Equation 1. To avoid part of the simultaneity in the variables of the right hand side, I estimate Equation 1 with GMM. However, this method eliminates *methodological* simultaneity only, as the series exhibits a high correlation given their underlying data generating process. I make use of lagged observations of the variables as instruments (IV), described and tested later. Recall that the problem that GMM addresses is the orthogonality condition $\mathbb{E}_t\left[\mathbf{x}_t' \varepsilon_t\right]$ that no longer holds. Hence, it is needed to instrumentalize the $\mathbf{x}_t'$ matrix with another one, say $\mathbf{z}_t$, containing ℓ IV ($\ell \geq k$) which fulfils:

$$\mathbb{E}_{t-1}\left[\left(\pi_t - \lambda x_t + \gamma_b \pi_{t-1} + \gamma_f \mathbb{E}_t\left[\pi^f_{t,t+h}\right]\right) \times \mathbf{z}_{t-1}\right] = 0 \,. \tag{2}$$

In this context, a formal test for IV suitability is analyzed through the Hansen's *J*-statistic:

$$J\left(\hat{\boldsymbol{\beta}}, \hat{\mathbf{w}}_T\right) = \frac{1}{T}\left(\pi_t - \mathbf{x}_t' \hat{\boldsymbol{\beta}}\right)' \mathbf{z}_t \, \hat{\mathbf{w}}_T^{-1} \, \mathbf{z}_t' \left(\pi_t - \mathbf{x}_t' \hat{\boldsymbol{\beta}}\right), \tag{3}$$

where $\hat{\mathbf{w}}_T$ is a $\ell \times \ell$ symmetric and positive-definite weighting matrix, as it weight the moments considered in the estimations. Hence, GMM finds the vector of coefficients:

$$\hat{\boldsymbol{\beta}} = \left(\mathbf{x}' \mathbf{z} \, \hat{\mathbf{w}}_T^{-1} \, \mathbf{z}' \mathbf{x}\right)^{-1} \mathbf{x}' \mathbf{z} \, \hat{\mathbf{w}}_T^{-1} \, \mathbf{z}' \mathbf{y} \,, \tag{4}$$

that minimizes Equation 3. As $J\left(\hat{\boldsymbol{\beta}}, \hat{\mathbf{w}}_T\right) \sim \chi^2_{l-k}$, along with the estimated coefficients it is also reported the *p*-value that test the null hypothesis: $\mathbb{E}_T\left[J\left(\hat{\boldsymbol{\beta}}, \hat{\mathbf{w}}_T\right)\right] = 0$. If $p\text{-value} > \alpha$, the IV are valid at the α-level of significance.

The estimation of the weighting matrix is made according to Hansen (1982) recommendation –the inverse of covariance matrix, i.e. $\hat{\mathbf{w}}_T = \hat{\mathbf{s}}^{-1}$, and avoiding potential autocorrelation with the Newey-West HAC method. The estimation of both

covariance matrices-for the two stages: IV and final regression –is set in the same manner. The whitening lag specification is set automatic, to be selected according the Bayesian Information Criterion (BIC) choosing in a maximum of three lags (following the rule $T^{1/3}$).

Despite the solution offered by the IV, some other problems could arise. A common setback is when IV are *weak instruments*. The problem could be easily explained when comparing the two available estimators –OLS $\left(\tilde{\boldsymbol{\beta}}\right)$ and GMM $\left(\hat{\boldsymbol{\beta}}\right)$: $\tilde{\boldsymbol{\beta}} = (\mathbf{x}'\mathbf{x})^{-1}\mathbf{x}'\mathbf{y}$ and $\hat{\boldsymbol{\beta}} = (\boldsymbol{\eta}'\mathbf{x})^{-1}\mathbf{x}'\mathbf{y}$ with $\boldsymbol{\eta} = \mathbf{z}\hat{\mathbf{w}}_T\mathbf{z}'$. So, the relative asymptotic bias could be expressed as:

$$\textbf{5}\ \text{Relative Asymptotic Bias} = \frac{\underset{T\to\infty}{\text{plim}}\left[\hat{\boldsymbol{\beta}} - \boldsymbol{\beta}\right]}{\underset{T\to\infty}{\text{plim}}\left[\tilde{\boldsymbol{\beta}} - \boldsymbol{\beta}\right]} = \frac{\mathbb{C}[\boldsymbol{\eta}, \boldsymbol{\varepsilon}]}{\mathbb{C}[\mathbf{x}, \boldsymbol{\varepsilon}]} \cdot \mathbb{C}[\boldsymbol{\eta}, \mathbf{x}]^{-1}.$$

From Equation (5) it is easy to notice that the higher $\mathbb{C}[\boldsymbol{\eta}, \mathbf{x}]$, the smaller the relative asymptotic bias. Note also that:

$$\begin{aligned}\textbf{6}\ \mathbb{V}\left[\hat{\boldsymbol{\beta}}\right] &= \sigma_{\varepsilon}^{2}(\mathbf{x}'\boldsymbol{\eta})^{-1}(\boldsymbol{\eta}'\boldsymbol{\eta})(\boldsymbol{\eta}'\mathbf{x})^{-1} \\ &= \sigma_{\varepsilon}^{2}(\mathbf{x}'\mathbf{x})^{-1}(\mathbf{x}'\boldsymbol{\eta})^{-1}(\boldsymbol{\eta}'\boldsymbol{\eta})(\boldsymbol{\eta}'\mathbf{x})^{-1}(\mathbf{x}'\mathbf{x}) = \mathbb{V}\left[\tilde{\boldsymbol{\beta}}\right] \cdot \rho_{\boldsymbol{\eta}\mathbf{x}}^{-2}.\end{aligned}$$

Hence, the lower the correlation between $\mathbf{x}$ and $\boldsymbol{\eta}$ $\left(\rho_{\boldsymbol{\eta}\mathbf{x}}\right)$, the higher the variance of the IV estimator relative to that of OLS. For the set of IV used in each estimation it is used the Stock and Yogo (2010) test, which null hypothesis is: *IV are weak*. Note that it is computed through the Cragg-Donald *F*-statistic. More details on the econometrics of weak instruments can be found in Bound, Jaeger, and Baker (1995), Stock, Wright, and Yogo (2002), and Moreira (2009). A deep overview for the specific case of the NKPC can be found in Nason and Smith (2008).

All the estimations are made through the GMM estimator. There are many reasons to prefer this method. First, and following GG, the GMM results are robust to the non linear IV GMM (NLIVGMM) estimator, which has been criticized by, for instance, Lindé (2005) and Rudd and Whelan (2005). This is a

good reason to keep GMM since NLIVGMM estimation requires more computer time and it is more sensitive to the IV election in a univariate ensemble. Hence, GMM is more efficient in the sense that Chumacero (2001) suggests, and it has proved to be as good as NLIVGMM when accommodating eventual specification bias.[5]

Second, GMM is also the preferred estimation method in several articles that follow GG especially with forecasting purposes. This is the case of Brissimis and Magginas (2008), Rumler and Valderrama (2010), Jean-Baptiste (2012), Kichian and Rumler (2014), and Posch and Rumler (2015) among others. It is often argued that the use of this estimator must be strongly attached to IV validation through Hansen's test and weak instruments results. Both elements are empirically analyzed later.

Finally, there is no a clear nor widely accepted reason to use an estimator different to GMM. GG response to Lindé (2005) proposal towards full information maximum likelihood (FIML) estimator relies heavily on a supposedly flaw simulation exercise.[6] As emphasized by Cochrane (2001), the election between one (GMM) or another (ML) estimator for univariate cases is a trade-off, and no consensus has been achieved. So, choosing GMM implies more sensitivity to IV selection but reducing misspecification risk to false assumptions made for the error term.

2.1 Data

Equation 1 involves three different kinds of series: actual inflation, inflation expectations, and the output gap. The source of all variables is the Central Bank of Chile (CBC). The available sample spans from 2000m1 to 2013m12 (168 observations).

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[5] An assessment of criticism response can be found in subsection 1.2 of GG.

[6] In particular, GG states in regard of the use of FIML: "[...] While we do not take a stand on this claim we find Lindé's argument unconvincing. In particular as we discuss below Lindé's Monte Carlo exercise is heavily tilted in favor of FIML." (p. 1110).

When forecasting, it is used the firsts 77 observations (2000m1-2006m5) as *estimation sample*, leaving the remaining 91 observations to *evaluation sample* (2006m6-2013m12). This scheme delivers 91 out-of-sample observations when predicting one-step ahead, 89 for 3-, 86 for 6-, and 80 for 12-months ahead.

Actual inflation –*headline inflation*– corresponds to annual percentage change of the total CPI (index level, 2013 = 100), the same measuring units in which the inflation target is set. For robustness exercises, I make use of another inflation measure, the so-called *core inflation*. This corresponds to the CPI inflation but extracting the components of *Food and beverages* and *Energy* (reducing exogenous volatility).

The inflation expectations are provided by the ChSPF.[7] The ChSPF is informed at the beginning of each month. Inflation forecasts are delivered for 1-, 12-, and 24-months ahead, along with projections of GDP for the current and following year. It collects answers from academics, consultants, executives and private sector consultants who also report forecasts for other variables. Since each individual analyst's projections are not revealed, the median forecast is used. The ChSPF starts in 2000 and several times has changed its content. Except for minor changes made since 2004m11, it has remained unaltered. On average over the period 2000-2009, 35 analysts completed the questionnaire each month.

Note that another source of inflation expectations is the Consensus Forecasts monthly report. However, the expectations provided there are made in a fixed-horizon basis. This is, every month it is reported the forecast for December of the current and next year. Hence, the information provided for intermediate horizons would be weaker than that coming from a moving horizon forecast. Moreover, this will redound into an inefficient forecast since the implied errors will show smaller errors at longer horizons that those made at shorter horizons.

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[7] Database freely available at <http://www.bcentral.cl/eng/economic-statistics/series-indicators/index_ee.htm>. See Pedersen (2010) for details.

Table 1

DESCRIPTIVE STATISTICS OF USED TIME SERIES[1]

	Symbol (stationary)	*Mean*	*Median*	*Standard deviation*	*Max.*	*Min.*	*ADF statistic[2] (level)*	*ADF statistic (annual var.)*
Inflation (headline)	π_t	3.18	2.96	2.17	9.85	−2.27	−0.24 (0.930)	−2.59 (0.096)
Inflation (core)	$\tilde{\pi}_t$	2.32	2.22	1.42	7.00	−1.63	−2.94 (0.154)	−4.06 (0.009)
EAMI	y_t	4.40	4.67	2.63	13.18	−4.43	−2.80 (0.199)	−3.04 (0.033)
ChSPF: inflation ($t+12$)	$\pi^f_{t,t+12}$	3.08	3.00	0.06	6.00	2.00	−3.99 (0.011)	
ChSPF: inflation ($t+24$)	$\pi^f_{t,t+24}$	3.07	3.00	0.17	3.90	2.60	−4.36 (0.003)	
ChSPF: EAMI ($t+1$)	-	4.17	4.50	2.08	13.00	−3.60	−2.74 (0.069)	
ChSPF: GDP (T)[3]	-	4.36	4.80	1.78	6.50	−1.80	−3.00 (0.037)	

ChSPF: GDP ($T+1$)	-	4.80	5.00	0.46	6.00	3.30	−2.72 (0.074)
Output gap Bwd	$\hat{y}_t$	−0.00	0.00	0.02	0.05	−0.06	−1.92 (0.053)
Output gap Fwd ($t+12$)	$\hat{y}^f_{t,t+12}$	−0.00	−0.00	0.02	0.07	−0.07	−2.83 (0.005)
Output gap Fwd ($t+24$)	$\hat{y}^f_{t,t+24}$	−0.04	−0.04	0.03	0.03	−0.09	−2.73 (0.072)
Real exchange rate	q_t	0.91	0.46	7.26	17.80	−15.57	−2.30 (0.021)
Oil price	p_t	19.97	14.51	36.52	170.88	−54.65	−4.92 (0.000)

Notes: [1]Sample: 2000m1-2013m12 (168 observations). [2]ADF stands for the augmented Dickey-Fuller unit root test. ADF p-value is shown in parenthesis. ADF computed with constant, trend [core, EAMI, ChSPF: inflation ($t+12$), ChSPF: inflation ($t+24$)], or none (output gap backward, output gap forward ($t+12$), real exchange rate, oil price). Bandwidth ranging from four to 24 lags. [3] t stands for monthly frequency, while T for annual.
Source: Author's elaboration.

Table 1 displays some descriptive statistics of all the series, including the output gap which is described in the next subsection. Basically, its construction relies on the use of the Economic Activity Monthly Index (EAMI, index level 2013 = 100), which constitutes a monthly measure of GDP.[8] Note that the preferred transformation to achieve stationary in level series is the annual percentage change. This transformation is preferred because it is achieved stationarity according to the Augmented Dickey-Fuller test it is an easy to interpret standard transformation, and matches the denomination of the ChSPF answers.

Finally, for robustness purposes, and considering this case as an open economy, there is also analyzed the real exchange rate and the Brent oil price (sources: CBC and Bloomberg) as independent stationary variables in Equation 1. Note that both headline and core inflation already include information from oil price, since there is a considerable pass-through to domestic prices (see De Gregorio, Landerretche, and Neilson 2007; and Pedersen, 2011, for details). In contrast, the real exchange rate considers a more genuine interaction dynamics between the domestic and foreign economies.

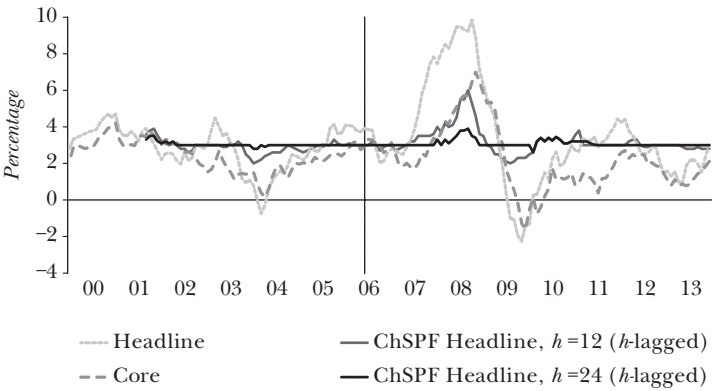
Figure 1 displays the actual and h-lagged forecasted inflation series across the whole sample. Note that the inflation expectation 24-months ahead [ChSPF: inflation $(t+24)$] is very close to the inflation target the majority of the time. Also, the time span includes the global inflationary spillover of the recent financial crisis.

Note that the use of ChSPF dataset is made under a number of implicit assumptions. One of the most important is that respondents minimize their mean squared forecasted error, i.e. quadratic loss function. This implies, among other results, that they are efficient into incorporating and using new available information. For an appraisal of the suitability of these projections, in Figure 2, I plot the cross-correlation between inflation

[8] Moreover, the annual rate of growth of the EAMI coincides with that of the GDP for each third month of each quarter. EAMI as well as inflation are freely available at: <http://si3.bcentral.cl/Siete/secure/cuadros/arboles.aspx>.

Figure 1

ACTUAL AND *H*-LAGGED FORECASTED HEADLINE AND CORE INFLATION[1]



[1] Vertical line indicates out-of-sample forecasts start point (2006.6).
Source: Author's elaboration using CBC's dataset.

(both) and the ChSPF expectations for 12 and 24 months. After noticing that the forecast is made for headline inflation, both expectations variables match the horizon at which they are targeting relatively well. As expected, however, it is a less clear cut with core inflation. In that case it is observed that expectations match the horizon with almost three or four lags but with a similar accuracy.

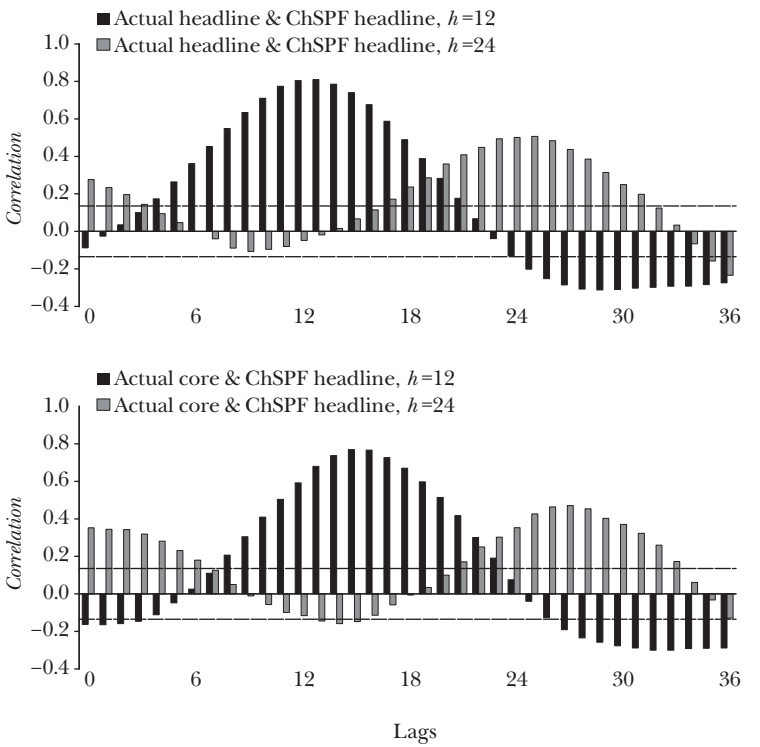
2.2 Output Gap Building Blocks

One of the major drawbacks when estimating the NKPC is the impossibility to accurately measure the excess of demand, i.e. marginal costs. The typical alternative is the output gap, i.e. the difference between the current and potential output.[9] Basically,

[9] Note that I focus on output gap instead of unemployment gap following the recommendations of Staiger, Stock, and Watson (1997a, 1997b).

Figure 2

CROSS-CORRELATION. INFLATION AND (LAGS OF) CHSPF EXPECTATIONS[1]



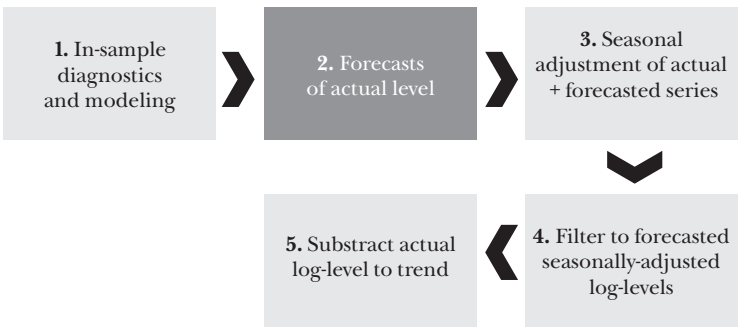
[1] Confidence interval: $0 \pm Z_{\alpha}/\sqrt{n}$, where α is the probability-level of the inverse normal distribution ($n = 168$) (see Chatfield, 2004, for details).
Source: Author's elaboration.

instability arise with the *end-of-sample* problem of filtering, especially when the Hodrick-Prescott (HP) procedure is used to obtain the potential output; an unobservable component.[10] To alleviate this setback, I follow the approach proposed by Bobbitt and Otto (1990) and Kaiser and Maravall (1999), relaunched by Mise, Kim, and Newbold (2005). This consists of

[10] See Orphanides (2001), Orphanides and van Norden (2002, 2005) and Garratt et al. (2008) for a discussion on this matter.

Figure 3

OUTPUT GAP BUILDING BLOCKS



Source: Author's elaboration.

adding forecasted observations to level series prior to perform any filtering procedure. Hence, the method applied to obtain the output gap follows the steps of Figure 3. Note that the seasonal adjustment is made with X-12-ARIMA in its default mode, and the filtering method is HP $(\lambda = 129{,}600)$.

As the method involves the use of forecasted observations, three measures of output gap emerges: *i)* using forecasted values up to five-years ahead (60 observations) coming from an ARMA(p, q) model (labelled: *Bwd*), *ii)* using ChSPF GDP forecast for the current year [*Fwd (t + 12)*], and *iii)* same as *ii)* but using forecast for the following year [*Fwd (t + 24)*]. As a result, three different matched specifications of the Equation 1 are analyzed:

1) a (now non-strictly) BL model, including lagged inflation only, plus *Bwd* output gap,

2) a FL model, including lagged inflation, the ChSPF expectations of inflation 12-months ahead, plus *Fwd (t + 12)* output gap, and

3) a FL model, including lagged inflation, the ChSPF expectations of inflation 24-months ahead, plus *Fwd (t + 24)* output gap.

The chosen ARMA model for EAMI corresponds to $\Delta^{12}Y_t = y_t = \alpha + \rho y_{t-1} + \theta_1 v_{t-1} + \theta_{12} v_{t-12} + v_t$, with $v_t \sim iid\ N\left(0, \sigma_v^2\right)$, chosen with the *general-to-specific* (GETS) iterative process allowing for skipped terms. The estimation is presented in Table 2, which also reveals robust results across the sample span, and a correct specification according to the Durbin-Watson statistic.

In Appendix A it is compared the stability across the sample of the purely BL and *Bwd* output gap measures to assess the stability gain using forecast observations. This procedure redounds into a more demanding BL benchmark for the HNKPC estimation and forecasts. As expected, the latter methodology exhibit minor deviations while the number of observation is increased.

Several articles use output gap as a proxy of marginal costs, differing often on the way how to obtain detrended output (whether based on HP or other device). The economic rationale behind this measure is striking; it considers the distance between the current state of the economy and the counterfactual that may be obtained if all factors were employed in the absence of shocks. Some examples using output gap are Rudebusch and Svensson (1999), Stock and Watson (1999), Lindé (2005), Paloviita and Mayes (2005), Rudd and Whelan (2005), Galí, Gertler, and López-Salido (2005), Canova (2007), Dees et al. (2009), Nunes (2010), and Jean-Baptiste (2012), among others. Moreover, Batini, Jackson, and Nickell (2005) use output gap alongside the labor share on the basis of an endogenously determined price mark-up.

Nevertheless, some other measures of marginal costs have been also used. In particular, GG and many other authors make use of the logarithm of the non-farm business labor income share. For the particular case of Chile, Pincheira and Rubio (2010) make use of the HP-based output gap, whereas Céspedes, Ochoa, and Soto (2007) of a more complicated specification relying heavily on structural assumptions (and ultimately

Table 2

AUXILIARY MODEL FOR EAMI (y_t) FORECASTS[1]

	Estimation sample	*Full sample*
Dep. variable	y_t	y_t
ρ	0.961 (0.000)	0.893 (0.000)
θ_1	−0.510 (0.000)	−0.226 (0.000)
θ_{12}	−0.489 (0.000)	−0.773 (0.000)
α	6.536 (0.000)	4.360 (0.000)
$\bar{R}^2$	0.656	0.741
D-W statistic	2.288	2.355
RMSE	1.209	1.324
Sample	2000m2-2006m5	2000m2-2013m12
Number of observations	76	167

Notes: [1] p-value shown in parenthesis. Variance corrected with Newey-West HAC. RMSE stands for root mean squared error.
Source: Author's elaboration.

depending on calibrated parameters). Due to frequency considerations (monthly in this article versus quarterly in Céspedes, Ochoa, and Soto, 2007), I am unable to replicate their marginal cost measure. Also, some of the input data used to build their marginal cost measure has suffered of a major methodological change since 2010 making difficult a fair extension of the sample (see INE, 2010, for details).

Finally, Stock and Watson (1999) suggest that especially when the aim is to forecast, the output gap measure provides a convenient alternative since relies basically in a univariate ensemble. Also, some of the major problems associated with output gap –instead of using marginal cost– are rather an empirical issue. Typically is the *end-of-sample* problem, already tackled in this article in an *efficient* manner according to Chumacero (2001).

2.3 Out-of-sample Assessment

To investigate whether the BL or one of the two FL specifications is better at forecasting, I compute and compare the root mean square forecast error (RMSFE):

$$\text{RMSFE}_h = \left[\frac{1}{T} \sum_{t=1}^{T} \left(\pi_{t,t} - \pi^f_{t,t-h} \right)^2 \right]^{\frac{1}{2}}, \quad (7)$$

where $\pi^f_{t,t-h}$ is the forecast h-step-ahead of $\pi_{t,t}$, made at period t. For completeness, and a more demanding comparison, I also include two competing models: the random walk (RWK), and an AR(p) model choosing p according to a fixed-T version of the *stepwise backwards* procedure (labelled: AR[SB]). This last model, similar to GETS, chooses the autoregressive order p within the estimation sample, fixing it until the last observation is used for estimation. Note that OLS deliver misleading results (not shown), implying that each forecast involve the multistage estimation once an observation is added to the sample (and dropping the last one under a rolling window scheme).

Finally, statistical inference is carried out with the GW test of predictive ability. It requires that errors have to be computed in a rolling window scheme, and works for both nested and non-nested models. The null hypothesis can be summarized as *both models have the same predictive ability conditional to its model* (see Clark and McCracken (2013), for a comprehensive description of the test.)

2.4 Robustness Exercises

Despite that the baseline exercises (in- and out-of-sample) are reestimated using core inflation, three more estimations are conducted. As above mentioned, to analyze whether international variables play a role in inflation dynamics, there is included in Equation 1 the real exchange rate (q_t) and the oil

price (p_t) separately. Hence, the equation to be estimated corresponds to:

$$\pi_t = \lambda x_t + \kappa g_t + \gamma_b \pi_{t-1} + \gamma_f \mathbb{E}_t \left[\pi^f_{t,t+h} \right] + \varepsilon_t \,, \tag{8}$$

where g_t is either q_t or p_t, and κ is a new parameter to be estimated. The remaining robustness exercise consists simply on the substitution of x_t as output gap and defining x_t as the annual percentage change of EAMI.

It is worth mentioning that all specifications, i.e. variables, lags, and IV, for the baseline close economy case were chosen following a t-statistic significant criterion in two sample spans: using the *estimation* sample and the *full* sample. Any specification that does not fulfil statistical significance within these two samples is discarded. If the specification fulfils the criterion, then it is analyzed its forecasting power and becoming the preferred specification. After having found the *preferred* specification it is analyzed the case with g_t variable, making use of the same lag and IV structure. Hence, analyzing simply the marginal information that g_t would provide.

3. RESULTS

3.1 In-sample Results

The results for the three specifications with headline are presented in Table 3 for two samples: *estimation* (1-5) and *full* sample (6-8). The J-stat. p-value indicates that IV are valid along the sample span except for the BL specification. The list of IV and its used lags is presented in Table 5. It also reports the weak instruments testing results. There are two other variables tested as IV: Consensus Forecasts' Brent oil price and ChSPF's foreign exchange rate. They both result as no valid IV with any acceptable lag length. Also, according to the Stock and Yogo (2010) test, the set of IV are not weak, so its variance estimation is not spoiled by IV bias.

Table 3

ESTIMATION RESULTS FOR HEADLINE INFLATION[1]

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Dep. variable	*Headline inflation:* π_t							
	Estimation sample					*Full sample*		
π_{t-1}	0.829 (0.000)	0.750 (0.000)	0.802 (0.000)	0.772 (0.000)	0.779 (0.000)	0.882 (0.000)	0.807 (0.000)	0.900 (0.000)
$\pi^f_{t,t+12}$	-	0.806 (0.032) [12]	0.890 (0.008) [12]	1.220 (0.003) [9]	1.144 (0.004) [9]	-	0.542 (0.000) [12]	0.356 (0.069) [9]
$\hat{y}_{t-1}$	0.210 (0.004) [1]	-	-	-	-	0.135 (0.043) [1]	-	-
$\hat{y}^f_{t,t+12}$	-	IV	−0.290 (0.397) [12]	-	-	-	IV	-
$\hat{y}^f_{t,t+24}$	-	-	-	IV	−0.012 (0.712) [1]	-	-	IV
Constant	0.543 (0.001)	−1.641 (0.075)	−2.200 (0.016)	−2.837 (0.008)	−2.702 (0.007)	0.400 (0.000)	−1.106 (0.004)	−0.699 (0.004)
J-statistic	0.000	0.879	0.520	1.307	1.218	4.496	4.065	3.688
J-stat. *p*-value	(0.979)	(0.644)	(0.470)	(0.520)	(0.269)	(0.033)	(0.130)	(0.158)
Sample	2000m5- 2006m5	2002m2- 2006m5	2002m2- 2006m5	2002m9- 2006m5	2002m9- 2006m5	2000m5- 2013m12	2002m2- 2013m12	2002m9- 2012m12
Number of observations	73	52	52	45	45	164	143	114

Notes: [1] *p*-value is shown in parenthesis; chosen lag is shown in square brackets, both below the coefficient estimates. Estimations with GMM. Weighting matrix estimation: covariance matrix inverse (with Newey-West HAC). Whitening lag specification: automatic with BIC, allowing up to three lags. IV stands for instrumental variable. Source: Author's elaboration.

Note that in both BL equations (1 and 4), the lagged inflation coefficients ranged from 0.83 to 0.88 (both significant). The output gap is significant with one lag (note that the first lag is allowed as it comes from a forecasted variable. In reality, delay in data release allows since two lags onwards). Equation 2 is the preferred with *Fwd (t + 12)*. In this case, the output gap is not significant with any lag between [1; 24]. Equation 3 shows the results when considering the 12-lag. As the data for t are sorted considering the h-period value, any lag between [1; 12] can be still considered as a forecasted value of π_t (in this case, lag 12 matches the targeted variable). Nevertheless, the output gap results as a valid IV. The FL coefficient accounts from 1.08 times bigger than the lagged coefficients in the first sample (Equation 2), declining to 0.67 times with the whole sample (Equation 7). The set of Equations 4, 5 and 8 mimics the results for *Fwd (t + 24)*. In this case, the decay in importance of the FL coefficient is more dramatic. For the first sample (Equation 4) accounts for 1.58 times to then decay to 0.40 with the full sample (Equation 8).

Table 4 shows the results for core inflation. Qualitatively these results are similar to headline but quantitatively their figures are more dramatic. The lagged inflation coefficient in the BL specification fluctuates between 0.77 and 0.91 (Table 4: Equations 1 and 6). The FL coefficient in the *Fwd (t + 12)* specification starts from 2.48 times the lagged coefficient, declining to 0.39 when considering full sample. Considering the *Fwd (t + 24)*, the FL coefficient accounts from 1.12 times with respect to the lagged, to just 0.19 with full sample.

All these results reveal instability in the parameters associated to FL inflation. To this end, in Figure 4, I display four graphs for each variable analyzing the evolution across the sample (recursive) of the key parameters: γ_b, γ_f, the t-statistic of γ_f, and the J-stat. p-value (keeping the same IV).[11]

[11] However, this analysis is simpler than that developed, for instance, in Swamy and Tavlas (2007) and Hondroyiannis, Swamy, and Tavlas (2009). In those studies, the authors make use of a

Table 4

ESTIMATION RESULTS FOR CORE INFLATION[1]

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Dep. variable	*Core inflation:* $\tilde{\pi}_t$							
	Estimation sample					*Full sample*		
$\tilde{\pi}_{t-1}$	0.768 (0.000)	0.526 (0.031)	0.650 (0.033)	0.645 (0.000)	0.885 (0.000)	0.914 (0.000)	0.867 (0.000)	0.939 (0.000)
$\pi^{f}_{t,t+12}$	-	1.303 (0.106) [12]	1.034 (0.181) [12]	0.725 (0.034) [12]	0.361 (0.117) [1]		0.336 (0.000) [12]	0.175 (0.012) [12]
$\hat{y}_{t-1}$	0.212 (0.000) [1]	-	-	-	-	0.065 (0.030) [1]	-	-
$\hat{y}^{f}_{t,t+12}$	-	IV	−0.082 (0.494) [2]	-	-	-	IV	-
$\hat{y}^{f}_{t,t+24}$	-	-	-	IV	−0.050 (0.048) [1]	-	-	IV
Constant	0.634 (0.005)	−2.473 (0.146)	−2.302 (0.166)	−1.305 (0.073)	−1.090 (0.038)	0.217 (0.008)	−0.725 (0.000)	−0.351 (0.051)
J-statistic	2.086	0.167	0.007	3.556	2.577	1.490	3.845	2.800
J-stat. *p*-value	(0.148)	(0.919)	(0.933)	(0.168)	(0.108)	(0.222)	(0.146)	(0.246)
Sample	2000m5- 2006m5	2002m2- 2006m5	2002m2- 2006m5	2002m9- 2006m5	2002m9- 2006m5	2000m5- 2013m12	2002m2- 2013m12	2002m9- 2012m12
Number of observations	73	52	52	45	45	164	143	114

Notes: [1]*p*-value is shown in parenthesis; chosen lag is shown in square brackets, both below the coefficient estimates. Estimations with GMM. Weighting matrix estimation: covariance matrix inverse (with Newey-West HAC). Whitening lag specification: automatic with BIC, allowing up to three lags. IV stands for instrumental variable. Source: Author's elaboration.

Table 5

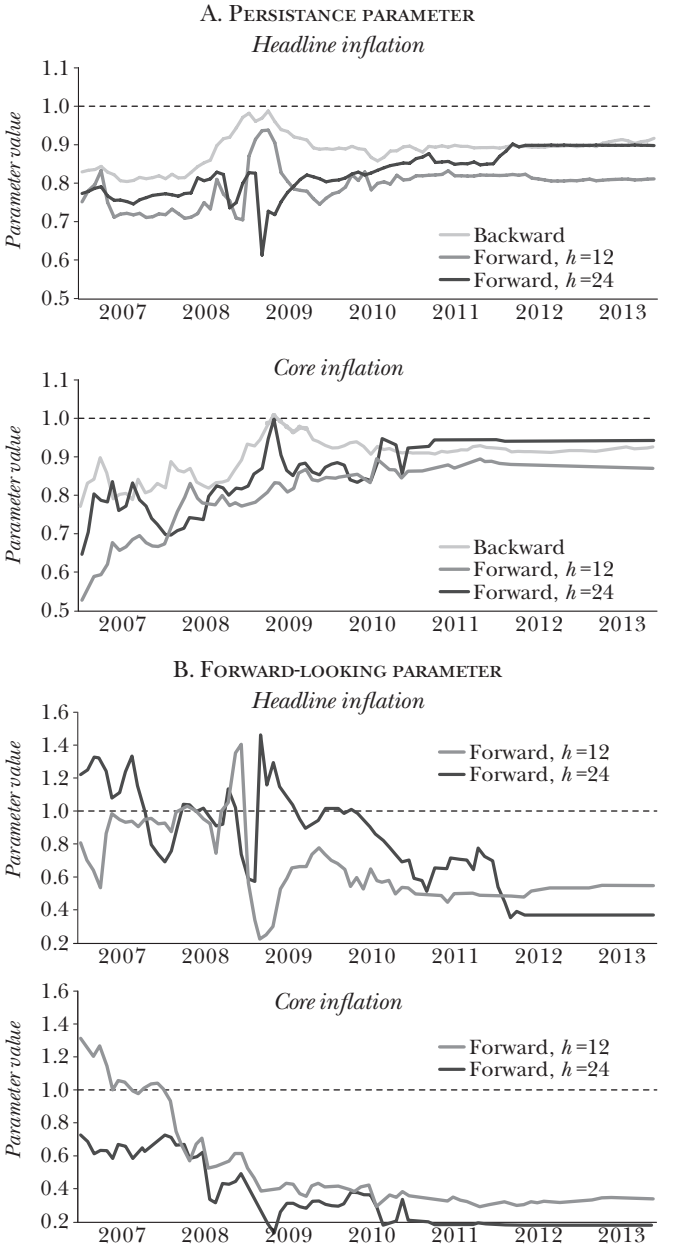
INSTRUMENTAL VARIABLES LIST

Equation	*Instruments*		*C-D F-statistic*[1]	*S-Y c.v.*[2]		*Relevant*
				10%	*25%*	*MSC*[3]
	Headline Inflation, Table 3					
1 6	Constant, π_{t-3} , π_{t-4} , $\hat{y}_{t-3}$	1 6	53.500	13.43	5.45	−2.600
2 3 7	Constant, π_{t-3} , $\pi^{f}_{t-24,t+24}$, $\hat{y}^{f}_{t-12,t+12}$, $\hat{y}^{f}_{t-25,t+12}$	2 7	77.040	16.87	6.28	−1.364
		3	0.226			0.221
4 5 8	Constant, π_{t-3} , $\pi^{f}_{t-24,t+24}$, $\hat{y}^{f}_{t-2,t+24}$, $\hat{y}^{f}_{t-20,t+24}$	4 8	7.208	16.87	6.28	−2.968
		5	7.273			−6.670
	Core Inflation, Table 4					
1 6	Constant, $\tilde{\pi}_{t-3}$, $\tilde{\pi}_{t-4}$, $\hat{y}_{t-2}$	1 6	91.704	13.43	5.45	−5.096
2 3 7	Constant, $\tilde{\pi}_{t-3}$, $\pi^{f}_{t-24,t+24}$, $\hat{y}^{f}_{t-12,t+12}$, $\hat{y}^{f}_{t-25,t+12}$	2 7	85.717	16.87	6.28	−4.612
		3	0.078			10.816
4 5 8	Constant, $\tilde{\pi}_{t-3}$, $\pi^{f}_{t-24,t+24}$, $\hat{y}^{f}_{t-2,t+24}$, $\hat{y}^{f}_{t-20,t+24}$	4 8	70.250	16.87	6.28	−4.933
		5	68.877			−9.043

Notes: [1]C-D *F*-statistic stands for Cragg-Donald *F*-statistic. [2] S-Y c.v. stands for Stock and Yogo (2004) critical values. [3] MSC stands for moment selection criteria. See Hall et al. (2007). Source: Author's elaboration.

Figure 4

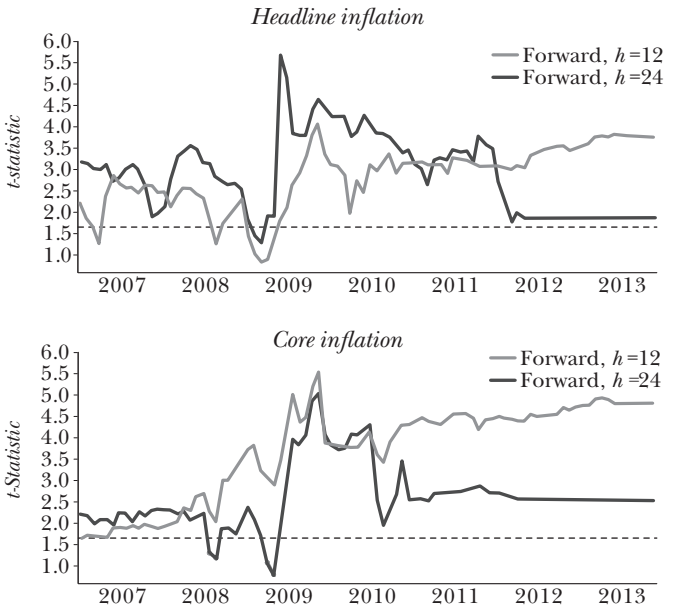
IN-SAMPLE RESULTS OF RECURSIVE PARAMETER ESTIMATION ACROSS FORECASTING SAMPLE[1]



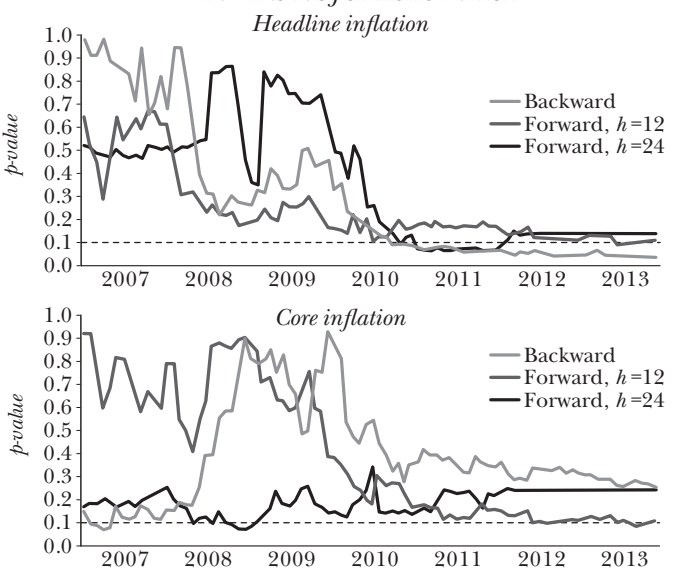
[1]A and B: Horizontal line = unit root bound.
Source: Author's elaboration.

IN-SAMPLE RESULTS OF RECURSIVE PARAMETER ESTIMATION ACROSS FORECASTING SAMPLE[1]

C. *T*-STATISTIC OF THE FORWARD-LOOKING PARAMETER



D. HANSEN'S *J*-STATISTIC *P*-VALUE



[1] C: Horizontal line = Z_{α}^{-1}, where α is the probability-level(10%) of the inverse norma distribution. D: Horizontal line: *p*-value =10%.
Source: Author's elaboration.

These results show that for headline the persistence parameter moves slowly around 0.80 to 0.90 at the end of the sample. However, different results are obtained for the FL parameter. A major shift is adverted in the aftermath of the financial crisis. While in 2009 the parameter reaches values even greater than one, since 2012 that is around 0.50 with the two FL specifications. The parameter is almost always significant, and the IV are valid until 2013 for the FL specifications only.

For core inflation the situation looks similar. However, almost all estimates remain steady since late 2009. The lagged coefficients look similar for the three specifications around 0.90, while the FL coefficient below 0.40 (significant along the sample). The IV are consistent, especially with the *Fwd (t + 24)* specification.

From this analysis it is possible to conclude that there is a robust but low role for expectations when determining current inflation. This evidence is shared for headline as well as core inflation.

The results of robustness exercises when using headline inflation are the following.[12] In Table 6 there are shown the estimations using the real exchange rate within the preferred specification for each output gap version using two sample spans. Note that these results are obtained after fulfilling statistical significance with the full sample for a given lag –or some lags–, and then analyze the results with the reduced sample. By doing so, Equations 4 to 6 using full sample reveal a significant but unclear role for real exchange rate, ranging from −6.0% to 7.6%. When considering FL measures, the coefficient is significant negative around 6% to 3%. However, the chosen lag length –the only significant– does not remain significant within the estimation sample, see Equations 1 to

time-varying coefficient environment to reduce bias specification, finding a minor role for lagged inflation in four European countries.

[12] The robustness results using core inflation are not reported for the sake of space, but they are available upon request.

3. Even if they were significant, the coefficients are unstable in both sign and size. Hence, this version of the HNKPC is discarded for a further forecasting analysis.

Table 7 present the results when using oil price. It is noticed qualitatively same situation than before: significance with full sample –Equations 4 to 6–, and erratic results with the short sample –Equations 1 to 3–. The elasticity is close to zero possibly because the information provided by oil prices is already included in the FL component of inflation as De Gregorio, Landerretche, and Neilson (2007) argues. Again, these estimations are discarded for further out-of-sample analysis.

Finally, Table 8 shows the results when instead of output gap it is used the annual percentage variation of EAMI. In this case, the results seems promising for forecasting exercises since the variable is significant when it is included in both the first- and second-step regression and with the expected sign. Note that the output gap is completely substituted by the growth rate, even as an IV. This is a particular convenient result when the aim is to forecast since same specification could produce accurate forecasts with less information –an issue addressed later. According to Table 8, there is a major role for lagged inflation, whereas FL component has declined it importance as more observations are included. Using the estimation sample, the ratio between FL and lagged component is greater than unity, while with the full sample it accounts between 32% to 54% only.

3.2 Out-of-sample Results

The results are presented in terms of the *RMSFE ratio* between the preferred FL specification (*pivot*) and a competing model:

$$\text{RMSFE Ratio}_h = \frac{\text{RMSFE}_h^{Fwd\,(t+k)}}{\text{RMSFE}_h^{Competing}} \cdot \quad (9)$$

Table 6

ESTIMATION RESULTS FOR HEADLINE INFLATION. REAL EXCHANGE RATE[1]

	1	*2*	*3*	*4*	*5*	*6*
Dep. variable:	*Headline inflation:* π_t					
	Estimation sample			*Full sample*		
π_{t-1}	0.837 (0.000)	0.758 (0.000)	0.772 (0.000)	0.887 (0.000)	0.764 (0.000)	0.852 (0.000)
$\pi^{f}_{t,t+12}$	-	0.799 (0.028) [12]	1.266 (0.017) [9]	-	0.778 (0.004) [12]	0.670 (0.002) [9]
$\hat{y}_{t-1}$	0.163 (0.017) [1]	-	-	0.265 (0.003) [1]	-	-
$\hat{y}^{f}_{t,t+12}$	-	IV	-	-	IV	-
$\hat{y}^{f}_{t,t+24}$	-	-	IV	-	-	IV
q_t	−0.007 (0.893) [16]	0.020 (0.304) [21]	0.002 (0.867) [21]	0.076 (0.042) [16]	−0.059 (0.068) [21]	−0.026 (0.060) [21]
Constant	0.550 (0.324)	−1.724 (0.042)	−2.973 (0.040)	0.314 (0.182)	−1.558 (0.619)	−1.496 (0.011)
J-statistic	0.000	0.060	1.475	0.000	2.237	1.022
J-stat. *p*-value	(1.000)	(0.806)	(0.220)	(1.000)	(0.134)	(0.311)
Sample	2001m5-2006m5	2002m2-2006m5	2002m9-2006m5	2001m5-2013m12	2002m2-2013m12	2002m9-2012m2
Number of observations	61	52	45	152	143	114

Notes: [1] *p*-value is shown in parenthesis; chosen lag is shown in square brackets, both below the coefficient estimates. Estimations with GMM. Weighting matrix estimation: covariance matrix inverse (with Newey-West HAC). Whitening lag specification: automatic with BIC, allowing up to three lags. IV stands for instrumental variable. Source: Author's elaboration.

Table 7

ESTIMATION RESULTS FOR HEADLINE INFLATION. OIL PRICE[1]

	1	*2*	*3*	*4*	*5*	*6*
Dep. variable:	*Headline inflation:* π_t					
	Estimation sample			*Full sample*		
π_{t-1}	0.819 (0.000)	0.866 (0.000)	0.775 (0.000)	0.919 (0.000)	0.926 (0.000)	0.744 (0.000)
$\pi^f_{t,t+12}$	-	0.499 (0.328) [12]	1.187 (0.004) [9]	-	0.326 (0.077) [12]	1.144 (0.008) [9]
$\hat{y}_{t-1}$	0.162 (0.004) [1]	-	-	0.197 (0.000) [1]	-	-
$\hat{y}^f_{t,t+12}$	-	IV	-	-	IV	-
$\hat{y}^f_{t,t+24}$	-	-	IV	-	-	IV
p_t	0.000 (0.966) [12]	−0.004 (0.300) [8]	0.000 (0.994) [12]	−0.009 (0.01) [12]	−0.008 (0.082) [8]	0.012 (0.096) [12]
Constant	0.547 (0.001)	−0.844 (0.465)	−2.745 (0.010)	0.477 (0.000)	−0.576 (0.191)	−2.901 (0.020)
J-statistic	11.067	1.054	1.346	0.000	1.910	0.000
J-stat. *p*-value	(0.000)	(0.304)	(0.245)	(1.000)	(0.082)	(0.988)
Sample	2001m1- 2006m5	2002m2- 2006m5	2002m9- 2006m5	2001m1- 2013m12	2002m2- 2013m12	2002m9- 2012m12
Number of observations	65	52	45	156	143	144

Notes: [1]*p*-value is shown in parenthesis; chosen lag is shown in square brackets, both below the coefficient estimates. Estimations with GMM. Weighting matrix estimation: covariance matrix inverse (with Newey-West HAC). Whitening lag specification: automatic with BIC, allowing up to three lags. IV stands for instrumental variable. Source: Author's elaboration.

Hence, figures below one are in favor of the *Fwd (t+k)* model, where $k = 12$ for headline and $k = 24$ for core. The results are presented in Table 9.

The results for headline show predictive gains in almost all cases. The exceptions are with respect to the RWK and the AR[*SB*] at $h = \{1; 3\}$. Note that when comparing to the other PC, the gains are qualitatively mixed: while higher gains are observed respect to *Fwd (t + 24)* at $h = \{1; 3\}$, it achieves 45.9% ($= 1 - 0.541$) when predicting at $h = \{6; 12\}$. The preferred specification is also better than both benchmarks when predicting at $h = \{6; 12\}$. According to the GW test, all differences are statistically significant except those with the BL specification.

The results for core reveals that the preferred specification *Fwd (t + 24)* outperforms the other FL specification, and both benchmarks when $h = 12$. The GW test reveals that only respect to *Fwd (t + 12)* at $h = \{1; 3\}$ the gains are statistically significant. However, note the BL specification is better at any horizon (but gains not significant). This result suggests that the lower variance of core respect to headline –i.e. its smoothness– inflates the relevance of the autoregressive term neglecting the inflationary FL variable (recalling that the forecast is made for headline).

In general, the out-of-sample exercise suggests that along with the ability of the HNKPC to explain inflation dynamics, it could be also considered as a valid benchmark model when forecasting at short-run. The predictive results for core inflation point out that its dynamics differs from those of headline, suggesting that core could be a process with higher memory (Granger and Joyeux, 1980). It is also suggested that the FL measures used are more related to the most volatile components of inflation. Conditional to the IV, the output gap measure plays a role within the BL specification delivering better results than its closer benchmark, AR[*SB*]. Further unexplored vignettes in this article may shed some light on core dynamics by analyzing some minor twists. For instance, nonlinearities in the (same) IV, and/or long-run forecasting horizons.

The results using the annual percentage variation of EAMI instead of output gap are presented in Table 10. As a robustness exercise, these results are compared to the baseline case. Hence, it is reported the ratio:

$$\text{RMSFE}_h \text{ Ratio Robustness} = \frac{\text{RMSFE}_h^{Annual\ variation}}{\text{RMSFE}_h^{Output\ gap}}, \quad (10)$$

where figures above unity implies a worst performance of the annual percentage change (*annual variation*) compared to the same specification when using output gap measure (*output gap*). In all the cases the baseline specification achieves a lower RMSFE except with the *Bwd* representing a predictive gain of 8%. Nevertheless, this gain is not statistically significant according to GW test.

Despite these results, the annual variation option still seems convenient and efficient given its simplicity. With headline inflation, the average *predictive loss* using the *Fwd 12* output gap across the horizons achieves 5%. This figure is even smaller at $h = 1$ and 3 around 2.8%. For the case of core inflation there is a similar situation. With *Fwd 12* output gap, the average predictive loss achieves 4.8%, and up to 2.4% at $h = 1$ and 3. Hence, the annual variation option seems as a valid second best alternative for inflation forecast.

4. CONCLUDING REMARKS

The aim of this article is to investigate to which extent FL measures of inflation help to explain inflation dynamics and their forecasts with a PC ensemble. This objective is tackled by analyzing the performance of the HNKPC, using a dataset of the Chilean economy, including inflation forecasts as a measure of inflation expectations.

To that end, I first estimate with GMM an unrestricted version of the HNKPC, to then compare its predictive power with a BL PC and traditional benchmarks predicting at $h = \{1; 3; 6; 12\}$-months-ahead.

Table 8

ESTIMATION RESULTS FOR HEADLINE INFLATION. ANNUAL PERCENTAGE CHANGE EAMI[1]

	1	*2*	*3*	*4*	*5*	*6*
Dep. variable:	*Headline inflation:* π_t					
	Estimation sample			*Full sample*		
π_{t-1}	0.944 (0.000)	0.710 (0.000)	0.807 (0.000)	0.968 (0.000)	0.886 (0.000)	0.876 (0.000)
$\pi^f_{t,t+12}$	-	1.056 (0.004) [12]	1.097 (0.031) [9]	-	0.290 (0.022) [12]	0.474 (0.041) [9]
y_{t-1}	0.063 (0.016) [1]	IV	IV	0.110 (0.000)	IV	IV
Constant	−1.123 (0.616)	−2.251 (0.011)	−2.610 (0.050)	−0.407 (0.006)	−0.499 (0.124)	−1.032 (0.106)
J-statistic	0.003	0.360	2.353	2.072	0.915	2.493
J-stat. *p*-value	(0.959)	(0.834)	(0.308)	(0.150)	(0.632)	(0.287)
Sample	2002m9- 2006m5	2002m2- 2006m5	2001m9- 2006m5	2002m2- 2013m12	2002m2- 2013m12	2001m9- 2013m9
Number of observations	73	52	57	164	143	145

Notes: [1] *p*-value is shown in parenthesis; chosen lag is shown in square brackets, both below the coefficient estimates. Estimations with GMM. Weighting matrix estimation: covariance matrix inverse (with Newey-West HAC). Whitening lag specification: automatic with BIC, allowing up to three lags. IV stands for instrumental variable. Source: Author's elaboration.

Table 9

OUT-OF-SAMPLE RESULTS. RMSFE RATIO[1]

	Headline Inflation					*Core Inflation*					
	Bwd	*Fwd 12*	*Fwd 24*	*RWK*	*AR[SB]*	*Bwd*	*Fwd 12*	*Fwd 24*	*RWK*	*AR[SB]*	*No. of observ.*
$h=1$	0.966	1.000	0.791[c]	7.757	9.360	2.507	0.707[b]	1.000	10.300	10.865	91
$h=3$	0.716	1.000	0.636[a]	1.242	1.511	2.162	0.721[b]	1.000	2.454	2.576	89
$h=6$	0.507	1.000	0.605[a]	0.373[b]	0.416[b]	1.901	0.815	1.000	0.980	1.099	86
$h=12$	0.541	1.000	0.787[b]	0.177[b]	0.193[b]	2.359	0.909	1.000	0.534	0.595	80

Notes: [1]RMSFE ratio stands for RMSFE(*Pivot*)/RMSFE(*Competing*). GW test results: [a] $p > 1\%$, [b] $p > 5\%$, [c] $p > 10\%$. Figures below one, in light gray; pivot in dark grey. AR[*SB*] stands for *stepwise backward* model selection; three lags chosen for headline and core inflation.
Source: Author's elaboration.

Table 10

OUT-OF-SAMPLE RESULTS. ANNUAL PERCENTAGE CHANGE EAMI (%EAMI)[1]

	Headline Inflation			*Core Inflation*			
	Bwd	*Fwd 12*	*Fwd 24*	*Bwd*	*Fwd 12*	*Fwd 24*	*No. of observ.*
$h=1$	1.913	1.027	1.057	3.451	1.012	1.130	91
$h=3$	1.698	1.030	1.127	2.895	1.024	1.148	89
$h=6$	1.363	1.118	1.318	2.158	1.068	1.120	86
$h=12$	0.920	1.021	1.697	1.197	1.089	1.016	80

Notes: [1]Each figure corresponds to RMSFE(%EAMI)/RMSFE (baseline output gap) for the same specification. Shaded cell: figure below unity.
Source: Author's elaboration.

The results show that the FL inflationary component is statistically significant when is included in the specification. In size, the preferred specification accounts from 1.58 to 0.40 times the lagged inflation coefficient; the latter figure considering whole sample. When considering short-term forecasting, I find predictive gains close to 45% (respect to the BL specification) and up to 80% (respect to the RWK) when forecasting at 12-months-ahead. However, these gains are not statistically significant. In sum, these results should be read carefully and the HNKPC just as a valid benchmark.

For robustness purposes, there are estimated same specifications with core inflation, plus an open economy analysis with real exchange rate or oil price. The in-sample results for core inflation support the existence of the HNKPC. Nevertheless, predictive results suggest that core could be a process with higher memory. The output gap plays a key role delivering better results than similar benchmark. None of the two openness measures used –real exchange rate nor oil price– deliver significant results in the reduced form.

Finally, the estimation using the annual variation of a monthly indicator of GDP instead of output gap deliver reasonable forecast accuracy but not as good as the preferred forecast – implied output gap measure.

Annex A. Output Gap Stability Analysis

One of the most desirable conditions for an unobservable variable is its stability. This can be understand as how robust is the measure while more observations are added to the sample. A more robust measure is that less invariant to new observations, and statistical inference can be carried out with a higher degree of reliability.

There are several measures towards stability assessment. Some common as well as useful measures are those contained in the X-12-ARIMA program in order to assess the seasonal

adjustment quality, i.e. *sliding spans* and *revision history*.[13] In this appendix it is described and employed the revision history technique to determine the effect of forecast observations in the stability of the output gap measure, compared with the case where no observations are added. This last situation is often referred as the *end-of-sample* identification problem.

The revision history is defined as the difference between the earliest estimation of a given observation obtained when that observation is the last available and a later estimation based on all future data available at the time. Hence, this measure is specifically concerned with the effect of new information on the historical record of the output gap and the variance contribution to the estimation and the forecast afterwards.

The revision history is calculated as follows. Let $\hat{y}_{t|t} = y_{t|t} - y^{\tau}_{t|t}$ the output gap measure (in logs) calculated using $y^{\tau}_{t|t}$ as a measure of potential output. $y^{\tau}_{t|t}$ corresponds to the trend component of the decomposition $y_{t|t} = y^{\tau}_{t|t} + y^{c}_{t|t}$, obtained with the HP filter using available data until observation *t*. Now, suppose that the same $\hat{y}_{t|t}$ measure is obtained considering all future data available until observation *T*, $\hat{y}_{t|T}$. The revision history is defined as:

A1 $$R_t = \hat{y}_{t|T} - \hat{y}_{t|t}.$$

Note also that the decomposition $y_{t|t} = y^{\tau}_{t|t} + y^{c}_{t|t}$ can be made by using the actual plus *h*-forecast-augmented variable, $y^{f}_{t|t+h}$, to improve its stability. In this case, the output gap corresponds to $\hat{y}_{t|t,f} = y_{t|t} - y^{f,\tau}_{t|t+h}$, while the revision history to:

A2 $$R_{t,f} = \hat{y}_{t|T} - \hat{y}_{t|t,f}.$$

The comparison comprises R_t and $R_{t,f}$, as R_t is related to the purely BL case and $R_{t,f}$ to the *Bwd* output gap measure. In Figure A1, the first panel show the revision history across the sample for output gap based on the purely BL potential output (▼

[13] See Findley et al. (1990) and Findley et al. (1998) for details.

-point is the *most recent* estimation $\hat{y}_{t|T}$). The second panel exhibit the revision history for *Bwd*. In both figures there is also depicted the average of both measures. Note that the difference between purely BL and *Bwd* accounts for approximately 0.20 $(\simeq 0.78 - 0.59)$ basis points, while the variances are 0.83% and 0.59%, respectively. Hence, the procedure proposed by Kaiser and Maravall (1999) of adding forecast observations prior to any filtering procedure deliver a more stable measure of output gap. This last characteristic is desirable since this variable is prone to exhibit a larger measurement error which may turn to spoiling both interpretation and inference.

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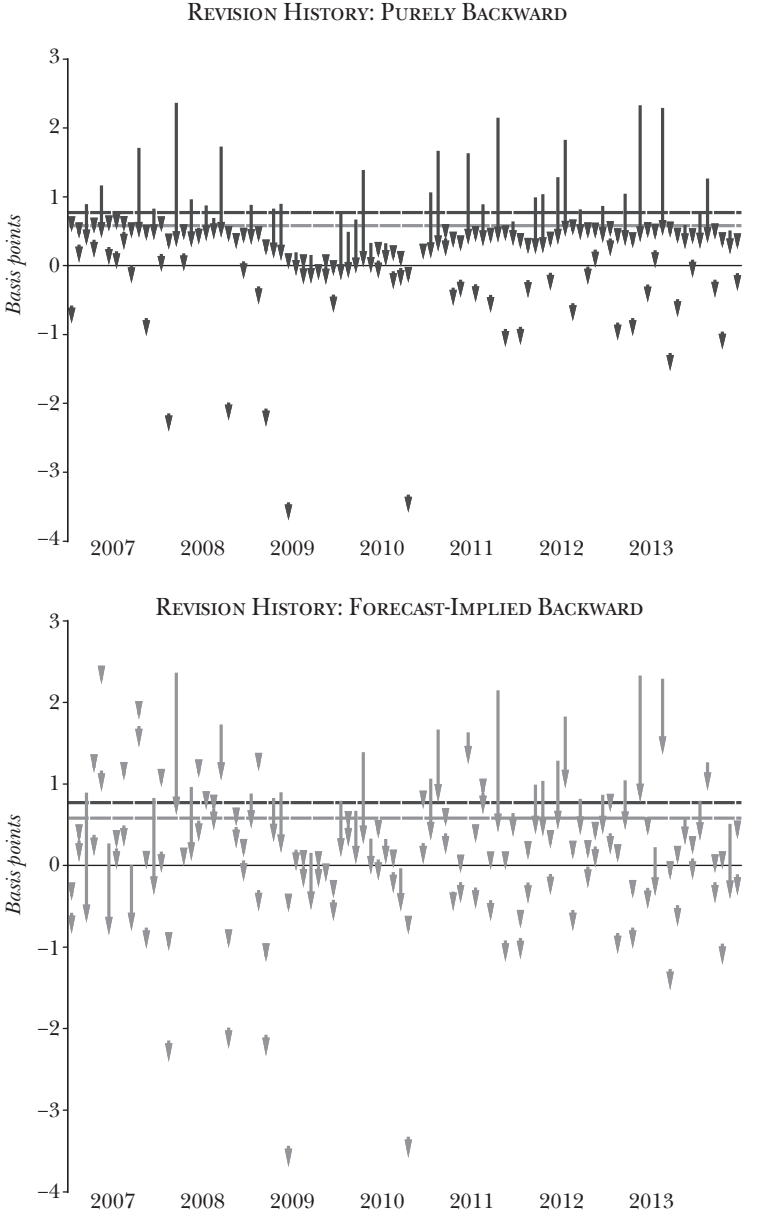
Figure A1

REVISION HISTORY COMPARISON



▼=Most recent.

Source: Author's elaboration.

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Household Debt and Uncertainty: Private Consumption after the Great Recession

Abstract

Household debt in many advanced economies has increased significantly since the 1980s and accelerated in the years before the Great Recession, resulting in an aggregate reduction of saving rates in the developed economies. Now, some of those economies are deleveraging, which may affect their recovery. We try to disentangle how these financial developments work for private consumption in a panel of OECD countries, after controlling for the traditional determinants (income, net financial and non-financial wealth and interest rates). We find that consistent with the perceived changes in the distribution of financial constrains across countries, aggregate consumption is also driven by the dynamics of housing debt accumulation and deleveraging.

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Precautionary savings, due to labor income uncertainty, have also influenced household decisions especially during the 2007-2009 period.

Keywords: Private consumption, financial developments, precautionary savings, debt.

JEL classification: E21, E44, F01.

1. INTRODUCTION

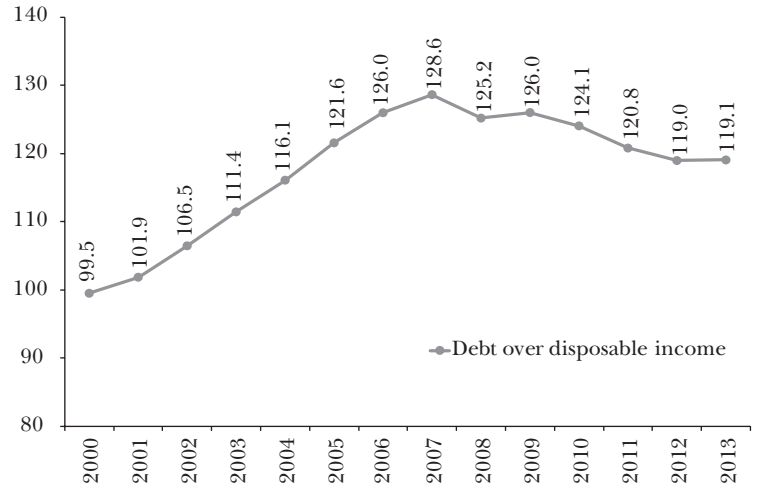
Household debt in most advanced economies has increased significantly since the 1980s and accelerated in the years before the Great Recession that started in 2007-2008 (see first panel of Figure 1). In fact, since 2000 the rapid debt growth has allowed consumption to grow faster than income. This has entailed a reduction in the saving rates of most developed countries during the expansionary phase of the business cycle (see second panel of Figure 1). Although this process has been heterogeneous across countries (Denmark and United Kingdom reduced their household saving rate by six percentage points, while it increased by four percentage points in New Zealand and Austria), the overall saving rate of the OECD countries declined by almost one percentage point between 2001 and 2007 (and the lending capacity by more than two percentage points).

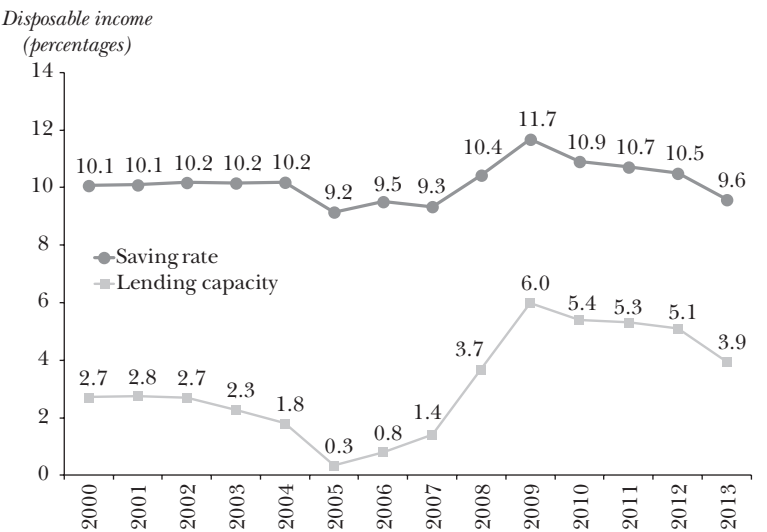
Some of those economies are deleveraging to achieve a sustainable level of debt relative to income and this balance-sheet restructuring may affect their recovery. In the early phase after the financial shock, the aggregate OECD household saving rate increased by more than two percentage points since 2007 (and the lending capacity by almost five percentage points), involving an adjustment in private consumption. Afterward, there has been a downward correction, although they are still above those observed in the Great Moderation period.

Many analysts have said that household *debt overhang* and the increase in house prices observed in many countries before 2007 could play an important role in explaining the consequences of the current financial crisis over the business cycle. In fact, we know that historically housing busts and

Figure 1

OECD COUNTRIES: HOUSEHOLD DEBT, SAVING RATE AND LENDING CAPACITY, 2000-2013





Source: Own calculations.

credit crunches are associated with deeper and longer-lasting recessions in advanced economies (Claessens et al., 2009). Moreover, this time recovery is taking place in an uncertain environment with persistently high unemployment rates. This paper studies the empirical influence on consumption of these factors.

There is considerable heterogeneity across countries regarding changes in the composition of assets and debt. In some of these countries, debt levels rose until 2007 in parallel with the increase in household wealth. In fact, the rise in gross household debt and the following correction has been associated with the developments in the housing market and, specifically, with the boom-bust of housing prices. That is the case for countries like the USA, the UK, Ireland or Spain, where house prices have been declining more (for example, Garrote et al., 2013). Whereas in Italy or Korea, the increase in household debt has been associated with consumer loans, which have very different characteristics from mortgages. And, at the other extreme, households in Germany and Japan have reduced their debt level since the 2000s. Figure 2 compares the notable differences since the 2000s between developments in debt, wealth, income and consumption in the USA and Germany.

Private consumption has increased more than disposable income in the USA since 2001, involving a decline in the saving rate in the years before the recession. Afterward, an adjustment in consumption was recorded jointly with a significant increase in the saving rate. By contrast, German households have expanded their saving rate over the whole period, and did not reduce consumption during the recession.

Figure 2 shows the enormous differences between the behavior of household balance sheets in these two economies. Household debt increased in the USA until 2007 and declined during the recession. These developments were anticipated by housing wealth, although the adjustment during the recession has been stronger on the assets than on the liabilities side. Since 2012, net financial assets and housing wealth have

recovered, while debt has continued to decline, closing the gap among them to the relative levels of 2000. By contrast, housing wealth in Germany declined during the expansionary period, stabilized afterward and begun to increase by 2011, while debt has continued to diminish. A similar analysis could be made looking at residential investment instead of consumption given the strong correlation between household debt, residential investment and housing prices.

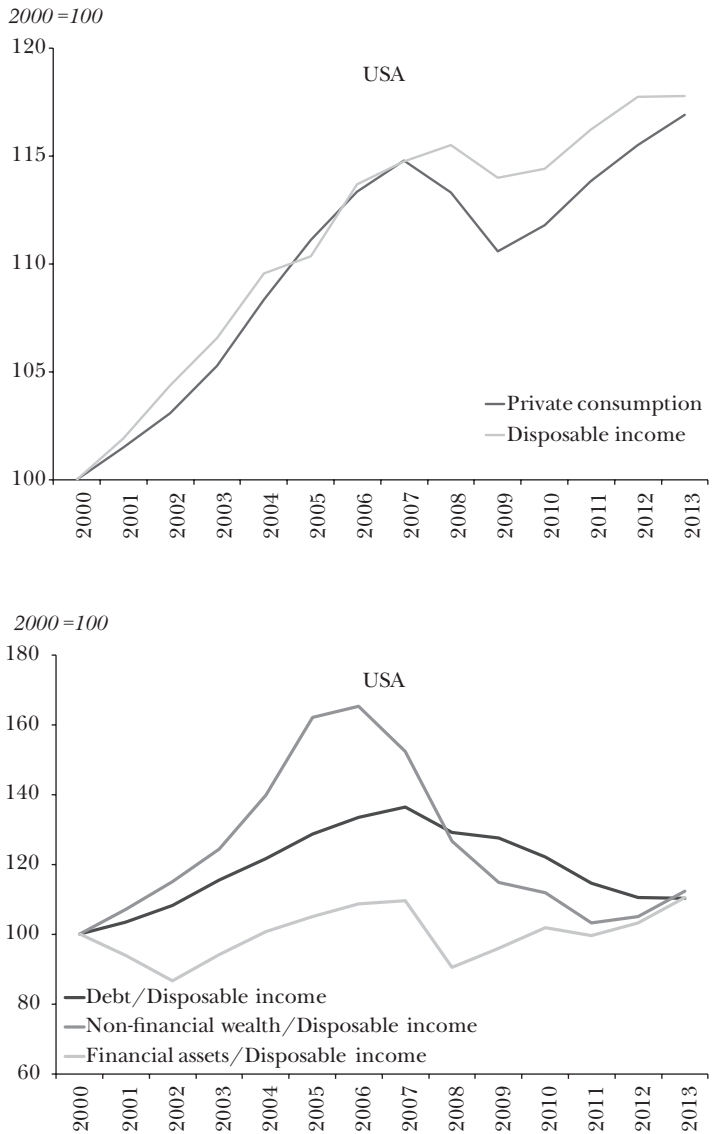
These changes in savings and balance-sheet composition have been influenced by technical and institutional changes in the financial sector during the last thirty years. Financial liberalization made it easier the availability of credit, especially in presence of borrowing constraints. For example, depending of the countries, households could borrow more easily against their wealth (mainly housing) significantly reducing their saving rate (Muellbauer, 2007). And the procyclicality of the financial system for real decisions is already well documented in the literature (for example, in the financial accelerator model of Bernanke and Gertler, 1989).

Moreover, the sudden reversal of the credit-loosening conditions after 2007 may have also exacerbated the consequences of the crisis. High leveraged households may want to downsize their mortgage or default. Others may want to reduce their obligations paying down their current debts and reducing new borrowing. For example, Mian and Sufi (2010) have documented that the regions of the US that have experienced the largest swings in household borrowing have also experienced the largest declines in employment and output. And at the theoretical level, Eggertsson and Krugman (2012) have shown that in presence of a deleverage shock, the level of debt matters. Highly indebted households face different constraints to low indebted households and these emphasize that the distribution of debt has effects especially with a zero bound interest rate constraint.

This paper tries to disentangle how these financial developments have influenced aggregated household consumption in the advanced economies considering the most recent period

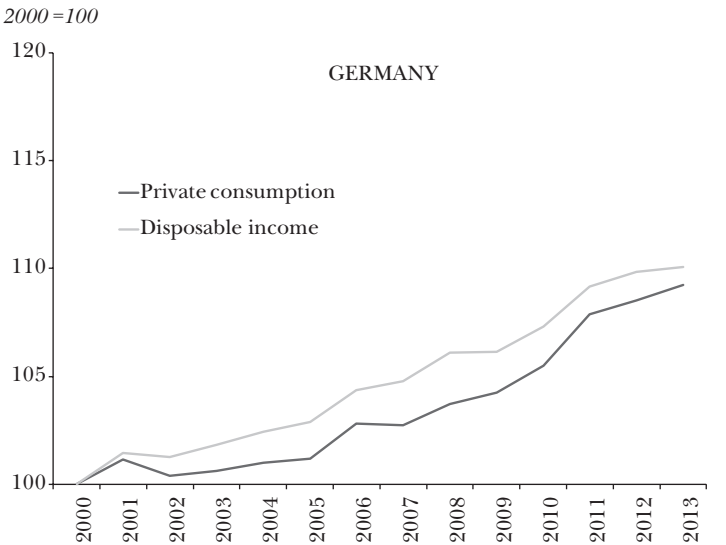
Figure 2

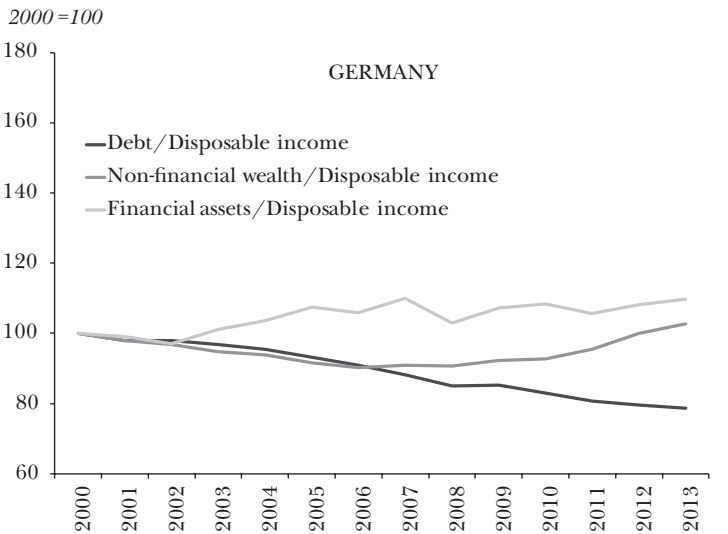
USA AND GERMANY: HOUSEHOLD CONSUMPTION, INCOME AND BALANCE SHEETS, 2000-2013



Source: Own calculations.

USA AND GERMANY: HOUSEHOLD CONSUMPTION, INCOME AND BALANCE SHEETS, 2000-2013





Source: Own calculations.

of house price boom-bust. In particular, we analyze empirically if the presence of credit constraints could make the debt ratio to have a relevant role explaining consumption dynamics across countries. For that purpose we use a panel of OECD countries in the 1980-2013 period, controlling for the traditional determinants of private consumption: Income, net financial and non-financial wealth, and interest rates.

A second factor closely related to the financial sector is the existence of households' uncertainty about their future income. Precautionary savings models show that the saving rate climbs (consumption falls) in response to an increase in uncertainty (see Carroll et al., 2012). Many advanced economies are experiencing sudden rises in the unemployment rate after the financial crisis in 2007 that may be considered by households as a permanent and unexpected shift in their labor income. Thus, we investigate the relevance of this precautionary effect on consumption once we have considered the wealth and debt effects to account for possible income and financial shocks.

Thus, the second section of the paper presents the empirical tests for these two additional financial factors in a (solved out) specification of private consumption. It also introduces the construction of the database and the empirical counterparts of the theoretical determinants of household decisions. The third section presents the econometric results where a dynamic consumption equation includes as additional factors the credit-channel and labor uncertainty. As robustness exercise, we will investigate in Section 4 whether these results may depend on the existence of non-Ricardian effects on private consumption given the recent rise in the public deficits and debt of many advanced economies. Fifth section analyzes the period after the financial crisis, 2008-2013, and whether these additional financial factors are having a differentiated effect on consumption across countries. Finally, section six summarizes the main conclusions and possible future research.

2. EMPIRICAL CONSIDERATIONS

Taking into account the policy analysis objectives of the paper, we follow Muellbauer (2007) and adopt the solved out consumption function approach, which integrates the intertemporal Euler condition and the budget constraint in just one equation. Besides, this will allow us to incorporate long run information on household decisions, which could be important, when departures from steady state may be very large in some countries. The most simple solved out consumption equation can be specified as follows:

$$1 \qquad LnC_{it}^{N} = \alpha_i + \beta LnY_{it} + (1-\beta) LnW_{it-1} + \gamma r_{it} + \varepsilon_{it}^{N}.$$

C^N being the non-durable consumption of households, Y their labor income, W their net wealth (including financial and real assets) and r the real interest rate. This specification implies that, in the long run, permanent income is captured through a weighted average of current income and non-human wealth. Note that the elasticity of consumption out of income and out of wealth is constrained to add to one. Thus, this could be interpreted as households trying to balance two ratios at the same time: Consumption over income (the saving rate) and wealth over income. The additional explanatory variable, the interest rate, will attain a negative effect $(\gamma < 0)$ on current consumption due to intertemporal substitution effects.

The empirical counterparts for the variables in this model are difficult to obtain for a broad sample of advanced economies since the 1980s, though the frequency of information is annual. In particular, labor income is proxied with disposable income, a more homogeneous measure of income, as it is directly obtained from National Accounts.[1] This implies that we are including part of the revenue generated by wealth, biasing upward the parameter β. Financial assets and liabilities are taken from the accounts of the different countries and

[1] The list of countries as well as the sources of variables used in the empirical analysis is detailed in Appendix 1.

non-financial assets are proxied with the housing stock at market prices. Due to data constrains, the nominal interest rate corresponds to the 10-year yields of government; therefore, it does not include the possible spread applied by financial institutions to consumers' loans.[2]

About consumption, it is also difficult to obtain a homogeneous measure of non-durable consumption for the whole sample. Furthermore, the classification of durable goods can change depending on the frequency of the data considered. This compels us to use total private consumption (C) obtained from the National Accounts as the dependent variable in Equation 1. Recent empirical evidence shows this does not need to be a limitation at all. On the contrary, durable consumption reacts much more than non-durable consumption both to expected and unexpected shocks to households' resources (Coulibaly and Li, 2006; Aaronson et al., 2012; Browning and Crossley, 2009). Durable goods act as insurance against unexpected shocks, and it is important to take them into account when we want to analyze the role of uncertainty. Moreover, this approach also controls for possible non-separabilities between both types of consumption.

However, including durability has implications for the solved out consumption function and for the random walk result of Hall (Mankiw, 1982). In particular, assuming the services of the durable goods enter into the utility function, and that these services are proportional to the stock of durables, it can be shown that not only current shocks are relevant to taking decisions today, but so are past shocks. That would suggest the inclusion of lagged consumption in the empirical specification. An *observable equivalent* conclusion would be reached

[2] International series of households' loan interest rates are available only for a very short time period. It was possible to obtain a banks' assets interest rate since 1980 for most of the countries in the sample; however, we prefer to use the risk free interest rate, assuming that the households specific risk premia could be captured by some of the other financial variables included in the consumption equation.

if we were to consider instead the existence of habits in non-durable consumption.

One of the most popular tests on consumption theory was that of excess sensitiveness; whereby several researchers found that changes in current income had informational content to forecast the growth rate of consumption. One explanation for this result was the existence of financially constrained consumers, which cannot be debtors, so they do not consume according to their permanent income but according to their current income. Therefore, for this type of households, consumption will be linked to current income (that is, $LnC_{it}^{c} = \rho LnY_{it}^{c} + \varepsilon_{it}^{c}$).

Denoting by λ the percentage of total consumption of constrained agents (this parameter may change over time) and assuming that the income of constrained and unconstrained households move in parallel, it is possible aggregate both formulations to obtain the consumption function for both types of households (Muellbauer and Lattimore, 1995). The expression, taking into account durable consumption, would be:

$$\begin{aligned} 2 \quad \Delta LnC_{it} = {} & \alpha_i' + \phi \Delta LnC_{it-1} + \lambda\theta \Delta LnY_{it} + \mu \Delta LnY_{it}^{exp} \\ & + \eta \Delta LnW_{it-1} + \psi \Delta r_{it} - \theta_2 (1-\lambda) \\ & \left[LnC_{it-1} - \beta LnY_{it-1} - (1-\beta) LnW_{it-2} + \gamma r_{it-1} \right] + \mu_t + \varepsilon_{it}. \end{aligned}$$

This expression resembles the traditional error correction model for private consumption. It establishes that private consumption growth will depend on the increase in their basic determinants (including some inertia) and the progressive correction from long-term desired consumption. Both country and time effects are included in the specification.

Short-term determinants of private consumption growth, there are three additional regressors considered by the literature that we will control for in the baseline specification. First, it is convenient to introduce a variable which captures household income growth expectations (Y^{exp}) to complement current

income and wealth.[3] Both expected income growth and current income growth could be jointly determined with consumption at this aggregate level; therefore, they will be instrumented with lags of the other variables in our preferred specification. Second, we consider the possible impact on aggregate consumption of income distribution, by including the Gini index (G). That takes into account that different subgroups of population could present a different propensity to consume out of income and wealth; we expect it to be negatively signed. And third, it has been argued that the elasticity out of net wealth should be different depending on the liquidity of the assets included in the portfolio. But besides the liquidity differences, the work among others of Aron et al. (2011) recognizes also the importance of credit conditions in the mortgage boom preceding the financial crisis and the subsequent significant drop. In order to control for those effects and because of the varying impact of institutional changes on the financial sector, the empirical analysis will distinguish between net financial assets (NFA) and housing wealth (HW). We would have liked to separate also shares and pension funds from the other financial assets, but sample limitations meant that this was not feasible.

Substantial empirical research with microdata during the last two decades has shown that different types of households respond differently to given changes in economic environment. Moreover, the crisis has shown that the responsiveness of groups to shocks has changed. And in the presence of a debt shock, highly indebted households respond differently than low indebted ones (see Eggerston and Krugman, 2012). In order to incorporate some of these composition effects in our aggregate analysis, we include the debt dynamics in our specification. Thus, our first testable hypothesis is that, once we have considered the traditional determinants, debt accumulation (D) first and deleveraging latter reflects changes in the credit conditions affecting households' decisions. It would

[3] This variable is taken from data of an OECD survey on households' economic sentiment (see Appendix 1).

indicate that both credit availability and the *excessive* household debt affects consumption once we have considered the net wealth effect. If so, adding current debt accumulation in the baseline model should favor consumption $(\omega_1 > 0)$ whereas past household debt accumulation should be negatively related to consumption $(\omega_2 < 0)$.

3 $$\begin{aligned}\Delta LnC_{it} = {} & \alpha_i' + \varphi \Delta LnC_{it-1} + \theta_1 \Delta LnY_{it} + \theta_2 \varphi \Delta LnY_{it}^{exp} + \theta_3 G_{it} \\ & + \eta_1 \Delta LnNFA_{it-1} + \eta_2 \Delta LnHW_{it-1} + \psi \Delta r_{it} + \omega_1 \Delta d_{it} \\ & + \omega_2 \Delta d_{it-s} + \omega_3 \Delta std(\Delta U_{it}) - \vartheta' \left[LnC_{it-1} - \beta LnY_{it-1} \right. \\ & \left. - (1-\beta) LnW_{it-2} + \gamma r_{it-1} \right] + \mu_t + \varepsilon_{it}.\end{aligned}$$

Obviously, contemporaneous changes in households' debt, our proxy for credit conditions, are an endogenous variable in this context, as long as it capture both demand side (jointly determined with consumption) and supply side developments in the credit market. Therefore, in order to check if credit constrains perform a role it is necessary to instrument this variable. We chose two instruments. The first is a predetermined demographic variable, the dependency ratio (percentage of population over 65), as long as data of households finances shows that at this age households start the process of wealth reduction, in line with life-cycle hypothesis. Second, we use the financial reform index constructed by Abiad et al. (2008), after being enlarged to take into account recent events in the financial sector, in order to isolate the changes in the regulatory environment that can be crucial in determining the credit supply conditions of every economy.

Beside the credit conditions, the existence of a risk perception about the household future income also affects their real decisions. In models of precautionary savings, households accumulate a larger stock of wealth to offset the increase in unemployment risk. And after a negative shock, consumption can overshoot the required downward adjustment (see Carrol, 2012).

Therefore, in Equation 3 we will also test if a measure of unemployment risk is quantitatively a relevant factor explaining

the recent drop in consumption relative to income across advanced economies ($\omega_3 < 0$). We proxy this effect using the standard deviation of the changes in the unemployment rate (U) in 5-year windows ($std(\Delta U)$). By using the first differences, we try to get rid-off of the structural component of the unemployment rate.

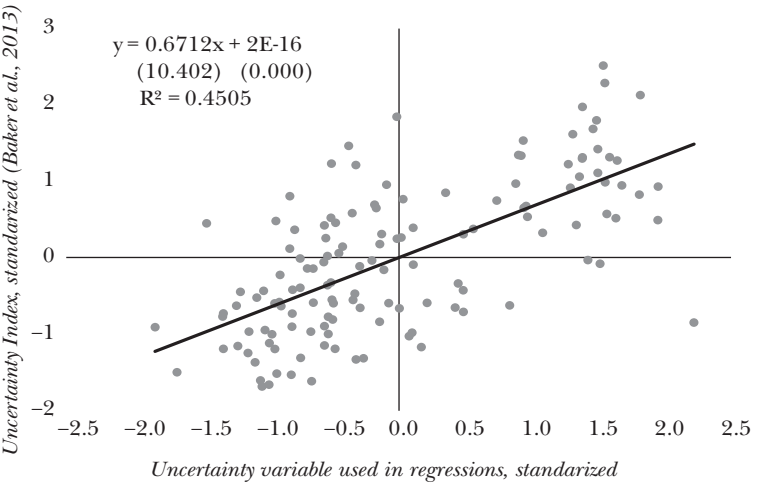
In Figure 3, this indicator of households' uncertainty shows a very high synchronization with more sophisticated measures of policy uncertainty such as those developed by Baker et al. (2013). In fact, for the countries (Canada, France, Germany, Italy, Spain, UK and USA) and the period (1997-2013 for the European countries, 1990-2013 for Canada and 1985-2013 for USA) where this economic policy uncertainty index is available, both indicators are positively correlated and the explanatory power is high. By country, the worst result is obtained in Germany, where the correlation is 0.26, compared to 0.85 for the UK. Clearly, the variability of the changes in unemployment rate is determined by other factors in addition to changes in monetary, fiscal or regulatory policies, which are the variables considered by this economic policy uncertainty index.

3. CONSUMPTION AND FINANCIAL CONDITIONS

Before testing the hypothesis about the influence of financial conditions, Table 1 presents the estimation results for the baseline consumption equation. As shown in the previous section, one of the main advantages of the solved out consumption function is that it incorporates long run information on household decisions. In fact, once the possibility has been considered that credit constrained households exist, the solved out consumption function can be understood as an error correction mechanism. From a statistical point of view, this is a very convenient representation, as private consumption and most of its determinants are non-stationary variables. Therefore, if they cointegrate, the deviations from that long run relation should provide valuable information for projecting the growth rate of consumption.

Figure 3

ECONOMIC POLICY UNCERTAINTY INDEX AND STANDARD DEVIATION OF THE FIRST DIFFERENCES OF THE UNEMPLOYMENT RATE



Source: Own calculations.

Thus, the estimation approach for the panel follows the traditional two-step procedure applied to single equation cointegrating relations. It involves assuming, once we have included fixed effects to control for non-observable characteristics and time effect to capture, for example, common aggregate shocks to all the countries, an identical form of long run consumption function for all countries and also a common function that measures the deviations from such a relation.

Table 1A presents the panel estimation of the long run relation. The variables in the regressions appear in levels and, aside from the real interest rate, in logs and per capita. Therefore, the coefficients should be interpreted as elasticities. Reverse causality and endogeneity of regressors could be a relevant issue. However, as in most specifications the variables are integrated, the superconvergence of the OLS guarantees the consistency of the parameters, though their distribution is not a standard one.

The first column considers current disposable income as the only determinant of consumption. The coefficient is statistically significant, positive and slightly higher than 1, reflecting a long run downward trend in the saving rate, probably associated with the development of the financial sector and social safety nets in most of these countries. In fact, the Fisher type test checking for the stationarity of the residuals (see, for example, Baltagi, 2008) accepts the null hypothesis that all panels contain unit roots, implying disposable income is not enough to explain the evolution of private consumption in the long run.

Therefore, we add another variable to the regression: Household net wealth (column 2). At this stage, net wealth is not disaggregated into its financial and non-financial counterparts, as long as the liquidity considerations that could justify different elasticities for these two components should not apply for a long enough timespan. This variable is significant and the parameter is positive, showing gains in the fit of the model. As expected, the corresponding coefficient of current income diminishes but still the stationarity tests show that the residuals of, at least, some panels contain unit roots.

If we add the real interest rate, the results continue to improve (column 3). It is signed negative (namely, an intertemporal substitution effect), and it is statistically significant, without changing the relevance of the other variables much.[4] In column 4 we check whether the parameters of current income and wealth add up to one, as implied by the theory. This constraint slightly worsens the fit of the model, but the real interest rate coefficient becomes more robust and the stationarity tests of the residuals show no unit roots at the 95% of probability. Thus, that is the specification whose residuals will be included in the estimation of the solved out consumption functions, to capture the error correction term.

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[4] Similar results hold when the risk free interest rate is replaced by a banks' assets interest rate as a proxy of the household interest rate.

Table 1A

LONG RUN ESTIMATES OF SOLVED OUT CONSUMPTION FUNCTIONS

Dependent variable: Per capita consumption. Fixed effects

	(1)	*(2)*	*(3)*	*(4)*
Constant	–0.404	–0.399	–0.304	–0.137
	(0.034)	(0.035)	(0.045)	(0.012)
Current income	1.078	1.033	1.020	0.972
	(0.009)	(0.014)	(0.014)	(0.007)
Net wealth (–1)	-	0.032	0.025	0.028[a]
		(0.007)	(0.007)	(–)
Real interest rate	-	-	–0.328	–0.529
			(0.101)	(0.086)
Standard deviation×100	4.709	4.525	4.489	4.539
	Residual stationary tests			
Fisher type (Inv. χ^2)	46.618	51.926	52.540	57.527
	[0.288]	[0.140]	[0.128]	[0.056]
Imm-Pesaran-Shin	–2.867	–2.307	–2.354	–2.279
	[0.002]	[0.011]	[0.009]	[0.011]
Number of observations	714	693	693	693

Notes: Standard deviations in round brackets; *p*-values in square brackets; [a] restricted coefficient.

The previous specification implies an estimated long run marginal propensity to consume of 0.4-1.1 cents out of one unit of wealth.[5] Although that value is below the estimates in the literature, some authors have argued that the *pure wealth effects* have been overestimated precisely so as not to consider precautionary or credit availability effects that are correlated with wealth (for instance, Carroll et al., 2012). We will analyze these effects in the

[5] This equation is specified in logs, so the estimated parameters represent elasticities. Therefore, the propensity to consume out of wealth would be equal to the elasticity multiplied by the ratio of consumption over net wealth, which, in our sample, shows a median of 0.20, the 10th percentile is 0.14 and the 90th percentile is 0.39.

short run specification. Furthermore, it should be taken into account that our proxy for human wealth is disposable income, which includes part of the revenues of wealth.

Table 1B presents the estimation results for the basic specification of the per capita consumption growth (Equation 2). Beside the income expectations and the Gini index terms, we incorporate separated wealth effects for financial assets and housing stocks.

The first column presents the OLS estimates including as an additional regressor the deviation of the long run relation (the error correction term). This parameter is negatively signed and is very significant, confirming the cointegration of the long run specification.

The results reveal the relevance of the net financial assets and the difficulty of finding a significant relation between housing wealth and consumption when pooling all the countries and periods. In fact, the lagged housing wealth was significant and negatively signed, implying that only progressive increases or decreases of housing wealth have effects on the consumption path. All the other coefficients, except the changes in the real interest rate and the Gini index, are statistically significant and have the signs predicted by the theoretical considerations.

When country dummies are included (column 2) or country and time dummies (column 3) we see a better fit and small changes in coefficients' significance. Finally, column 4 also tries to control for the endogeneity of income (current and expected) with lags of all the right side variables as instruments. These instruments seem to be orthogonal with the residuals (see the Sargan test).

Analyzing the IV estimates, the current income and the income expectations coefficients become not significant. However, countries with an increase in income inequality (higher Gini index) have lower consumption growth. This indicates that societies where the share of income in the top deciles is high have a higher saving rate. Moreover, under this specification both financial assets and housing stocks are significant for consumption, but in the latter case is the acceleration effect that is relevant as

Table 1B

ESTIMATION OF BASIC CONSUMPTION FUNCTION

Dependent variable: Per capita consumption growth

	(1)	*(2)*	*(3)*	*(4)*
	OLS	*OLS*	*OLS*	*IV*
Constant	0.007[c]	0.007[b]	0.014[c]	0.001
	(0.001)	(0.003)	(0.004)	(0.004)
Consumption growth (–1)	0.194[c]	0.154[c]	0.137[c]	0.191[c]
	(0.034)	(0.035)	(0.036)	(0.045)
Income growth	0.448[c]	0.373[c]	0.326[c]	0.214
	(0.031)	(0.031)	(0.032)	(0.150)
Income growth expectations	0.019[c]	0.051[c]	0.046[c]	0.028
	(0.004)	(0.006)	(0.006)	(0.023)
Gini index change (–1)	–0.102	–0.134[a]	–0.139[a]	–0.148[b]
	(0.078)	(0.075)	(0.073)	(0.076)
Net financial assets growth (–1)	0.035[c]	0.034[c]	0.022[c]	0.026[c]
	(0.005)	(0.005)	(0.006)	(0.007)
Housing wealth growth (–1)	0.026[b]	0.029[b]	0.033[b]	0.048[c]
	(0.013)	(0.013)	(0.013)	(0.015)
Housing wealth growth (–2)	–0.020[a]	–0.023[b]	–0.029[b]	–0.023[a]
	(0.012)	(0.012)	(0.012)	(0.013)
Real interest rate change (–1)	–0.005	–0.014	–0.061	–0.091[b]
	(0.038)	(0.036)	(0.040)	(0.046)
Error correction mechanism	–0.085[c]	–0.073[c]	–0.063[c]	–0.070[c]
	(0.014)	(0.014)	(0.014)	(0.024)
Country dummies	No	Yes	Yes	Yes
Time dummies	No	No	Yes	Yes
R^2	0.563	0.612	0.678	0.667
Standard deviation×100	1.514	1.427	1.299	1.364
Durbin-Watson	1.838	1.830	2.079	1.899
Sargan test	-	-	-	16.342
				[0.231]
Number of observations	642	642	642	601

Notes: Standard deviations in round brackets; *p*-values in square brackets; [a], [b] and [c] significant at 10%, 5% and 1%, respectively. Instruments: Variables lagged two to three periods.

opposed to the growth effect in the former case. Also the real interest rate change is relevant to consumption. The speed of adjustment of this cross-country equation (0.07) seems low compared with time series studies (Aron et al., 2012), even taking into account the relevance of the lagged consumption growth in our estimates. In order to analyze the sensitivity of the results to the country heterogeneity, we repeated these regressions using exclusively the sample of EU countries.[6] Qualitatively the results did not change, but, quantitatively, it is remarkable that the Gini index lost its statistical significance, probably due to the homogeneity of this variable among the European countries; beside, the elasticity out of net wealth is higher, something that could be related to the higher average population age in this area.

The estimated wealth coefficients imply a short run marginal propensity to consume of 0.5-1.6 cents out of one unit of net financial wealth and 0.7-1.8 cents out of non-financial wealth. These results are difficult to compare with the work of Case, Quigley and Shiller (2005, 2013), that finds a higher MPC out of housing wealth than out of financial wealth with the data of 14 countries in the period before the last housing boom (1975-1999). The main reason is that, unlike our work, they consider a financial wealth variable that excludes the least volatile components of financial wealth such as deposits, securities or insurance reserves. Our results are more similar to Ludwig and Sløk (2004), since they cannot conclude that the elasticity of housing differs from that of financial assets. But in this case, the study only consider the behavior of stock and housing prices (and not the quantities) in the determination of the effect of both wealth components on consumption.

We are trying to determine whether the leverage process first and deleveraging latter on is a specific determinant of consumption growth, in beside the traditional passive role the debt ratio plays through the wealth effect (Dynan, 2012). This active role could be the result of households targeting a particular leverage level, or financial institutions using leverage as an indicator

[6] These results are available upon request.

of households' soundness. Thus, beside the consideration of net wealth, debt accumulation may reflect improving credit conditions. And similarly, households may want to reduce their leverage when house prices fall, especially when they see a high probability of job loss. As initial evidence of the existence of such an effect in the most recent period, we present a scatter plot with the average cross-country residuals of the consumption equation (Table 1b, column 4) between 2008 and 2013 and the change in (the log of) the ratio of household debt to income in the same period and in a previous expansionary period (2001-2007). In Figure 4 we see, first, that countries with higher negative (positive) residuals after the Great Recession have been also characterized by a reduction (increase) in the debt to income ratio during the same period. At the same time, these were the countries where the debt to income ratio increased the most (least) in the Great Moderation period. This suggests that countries with higher (and negative) consumption residuals are the ones with a higher debt ratio in the period previous to the beginning of deleveraging.

However, these are simple correlations calculated for a very specific sample period. It is necessary to check how debt works in a fully specified consumption equation over a longer horizon, to analyze any possible additional effect. Therefore, in Table 2 we reestimate the last specification in Table 1B adding the contemporaneous and lagged growth of the household's debt.[7]

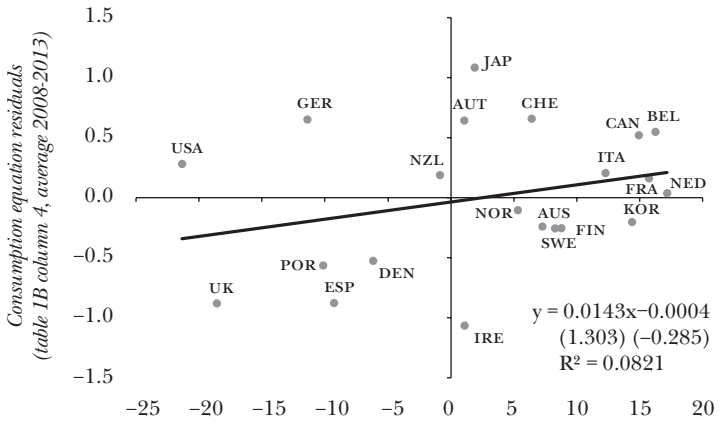
The debt growth coefficient is positive and significant when enters contemporaneously (columns 1 and 2) and negative and significant with a time lag of two years (columns 3 and 4). Thus, after controlling for net wealth and the other traditional

[7] In fact, we have chosen the lag of debt growth providing the lowest Sargan test among the first four lags, which were statistically significant on individual basis. When household debt to income growth was considered instead of household debt growth the estimation results did not change except for the coefficient of the current disposable income.

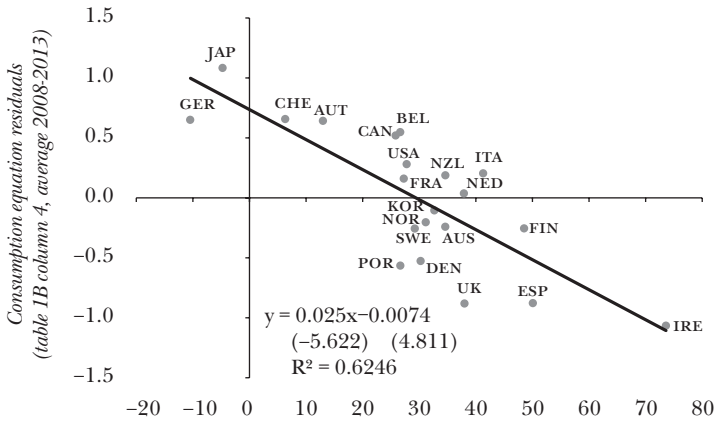
Figure 4

CONSUMPTION RESIDUALS (2008-2013) AND HOUSEHOLD DEBT
(percentages)

A. CONTEMPORANEOUS CORRELATION



B. LAGGED CORRELATION



Source: Own calculations.

ESTIMATION OF THE CONSUMPTION FUNCTION: HOUSEHOLDS' DEBT AND UNCERTAINTY EFFECTS

Dependent variable: consumption growth per capita. Country and time fixed effects

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	OLS	*IV*	*OLS*	*IV*	*OLS*	*IV*
Constant	0.009[b]	0.001	0.010[c]	0.002	0.011[c]	0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Consumption growth (–1)	0.047	0.151[c]	0.061[a]	0.129[c]	0.061[a]	0.124[c]
	(0.035)	(0.046)	(0.034)	(0.046)	(0.034)	(0.044)
Income growth	0.263[c]	0.229[a]	0.271[c]	0.315[b]	0.263[c]	0.298[b]
	(0.030)	(0.134)	(0.030)	(0.135)	(0.029)	(0.131)
Income growth expectations	0.035[c]	0.016	0.034[c]	0.006	0.034[c]	0.007
	(0.005)	(0.021)	(0.005)	(0.021)	(0.005)	(0.020)
Change in the Gini index (–1)	–0.111	–0.127[a]	–0.113[a]	–0.118[a]	–0.115[a]	–0.119[a]
	(0.068)	(0.073)	(0.067)	(0.071)	(0.065)	(0.069)
Net financial assets growth (–1)	0.021[c]	0.025[c]	0.020[c]	0.023[c]	0.015[c]	0.018[c]
	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)
Housing wealth growth (–1)	0.025[a]	0.041[c]	0.025[b]	0.035[b]	0.016	0.027[a]
	(0.013)	(0.014)	(0.012)	(0.015)	(0.012)	(0.014)
Housing wealth growth (–2)	–0.030[c]	–0.024[a]	–0.018	–0.015	–0.014	–0.011
	(0.011)	(0.013)	(0.011)	(0.013)	(0.011)	(0.012)
Real interest rate change (–1)	–0.040	–0.078[a]	–0.051	–0.077[a]	–0.056	–0.075[a]
	(0.037)	(0.044)	(0.037)	(0.043)	(0.036)	(0.042)
Households debt growth	0.133[c]	0.060[b]	0.144[c]	0.093[c]	0.141[c]	0.092[c]
	(0.014)	(0.030)	(0.014)	(0.032)	(0.013)	(0.031)
Households debt growth (–2)	-	-	–0.049[c]	–0.038[b]	–0.045[c]	–0.036[b]
			(0.012)	(0.016)	(0.012)	(0.015)
Changes in uncertainty	-	-	-	-	–0.011[c]	–0.012[c]
					(0.002)	(0.002)
Error correction mechanism	–0.058[c]	–0.073[c]	–0.057[c]	–0.081[c]	–0.057[c]	–0.083[c]
	(0.013)	(0.022)	(0.013)	(0.022)	(0.013)	(0.021)
R^2	0.724	0.694	0.731	0.706	0.745	0.724
Standard deviation×100	1.204	1.291	1.188	1.255	1.156	1.221
Durbin-Watson	1.808	1.937	1.886	1.981	1.862	1.919
Sargan test	-	21.449	-	17.251	-	20.751
		[0.207]		[0.438]		[0.238]
Num. observations	642	601	642	601	642	601

Note: Standard deviations in round brackets; *p*-values in square brackets; [a], [b] and [c] significant at 10%, 5% and 1%, respectively. Instruments: Variables lagged two to three periods plus dependency ratio contemporaneous and lagged one period and financial liberalization index lagged one and two periods.

determinants, an increase in debt rises current consumption growth whereas it has a negative effect in future consumption. The adjustment of the equations with debt is better and only the lagged growth of housing wealth is not statistically significant compared to the previous specification. Moreover, when the endogeneity of income and debt is considered, the expected income variable becomes insignificant and the lagged consumption variable coefficient becomes significant but less relevant than previously. And when these regressions are run only for EU countries, the contemporaneous and lagged debt growth coefficients slightly diminish in absolute value, resulting in a reduced but statistically significant response of consumption to debt accumulation and deleveraging.

Now, compared with the IV results in Table 1, the housing wealth effect becomes less significant and with a lower coefficient. The difference with the other wealth variable (net financial) is notorious, as in this case the coefficient remains unchanged and continue being very significant. Probably, part of the sensitivity of housing wealth in previous specifications was capturing the existence of credit constraints due to its role as collateral (see Mian, 2012). Also Muellbauer and his coauthors (for instance, Aron et al., 2011) have shown that the easing of credit standards during the 2000s was linked to the boom in house prices and that has influenced consumption behavior in countries like the USA or the UK. But we recognize that some of the debt significance may also capture the households' credit risk that is absent in our simple risk free interest rate measure.

The second additional financial factor considers a precautionary savings effect. Thus columns 5 and 6 in Table 2 incorporate our measure of labor uncertainty: The volatility of the change in unemployment. All else being equal, we find that an increase in income uncertainty reduces consumption as result of precautionary behavior.[8] As expected, all the other esti-

[8] The empirical analysis suggests that it is the change in our proxy for uncertainty what is relevant for the change in consumption.

mated parameters remain with very similar coefficients aside from those of wealth, which diminish again. Therefore, in our dataset the volatility of the change in the unemployment rate seems a good proxy for the labor income risk. This result is similar to the one found by Mody et al. (2012), but in their case uncertainty is measured by the level of unemployment rather than its variability.

The term premium is a possible additional financial factor to explain consumption dynamics. And this could become more relevant in the last part of the sample period when official interest rates were bounded to zero and central banks were very active implementing non-conventional policies to affect long term yields. Nevertheless, when we included a term premium (ten years sovereign bonds minus three month money market) in previous regressions the coefficient was negative but insignificant. That result holds with or without debt growth and labor uncertainty in the specification.[9]

We can use these results to illustrate how the components of wealth (including the additional effect of debt) have influenced the behavior of consumption and saving in different countries in the last decade, using the estimated equation in Table 2. The countries selected show different dynamics of consumption and the indebtedness level. Thus, the first panels of Figure 5 present the behavior of these variables both in USA and Germany, which we saw in the introduction, were showing notable differences in the debt and wealth developments before the crisis. There was a lack of synchronization between these two economies in that respect and gives a partial explanation for the observed pattern of consumption. At the beginning of the 2000s Germany presented relatively high indebtedness, and its deleveraging process represented

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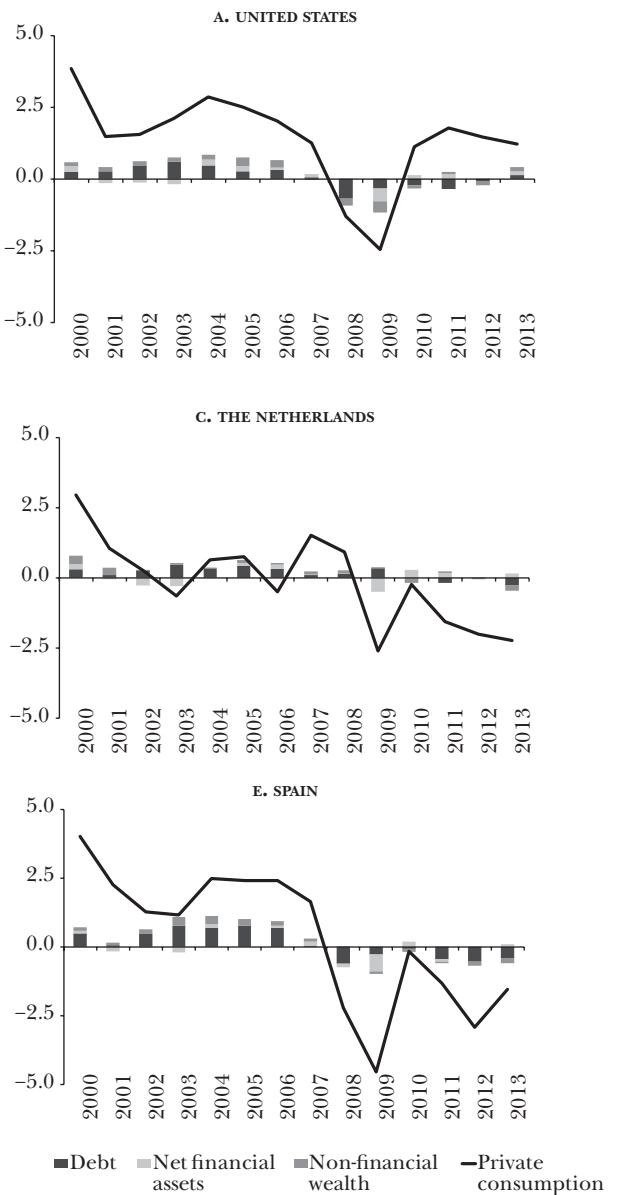
This is consistent with theory, as if the level of uncertainty affects saving ratio, it should be the changes in uncertainty what influences the changes in consumption.

[9] Only when disposable income and lagged consumption were dropped from the equations this variable became significant.

Figure 5

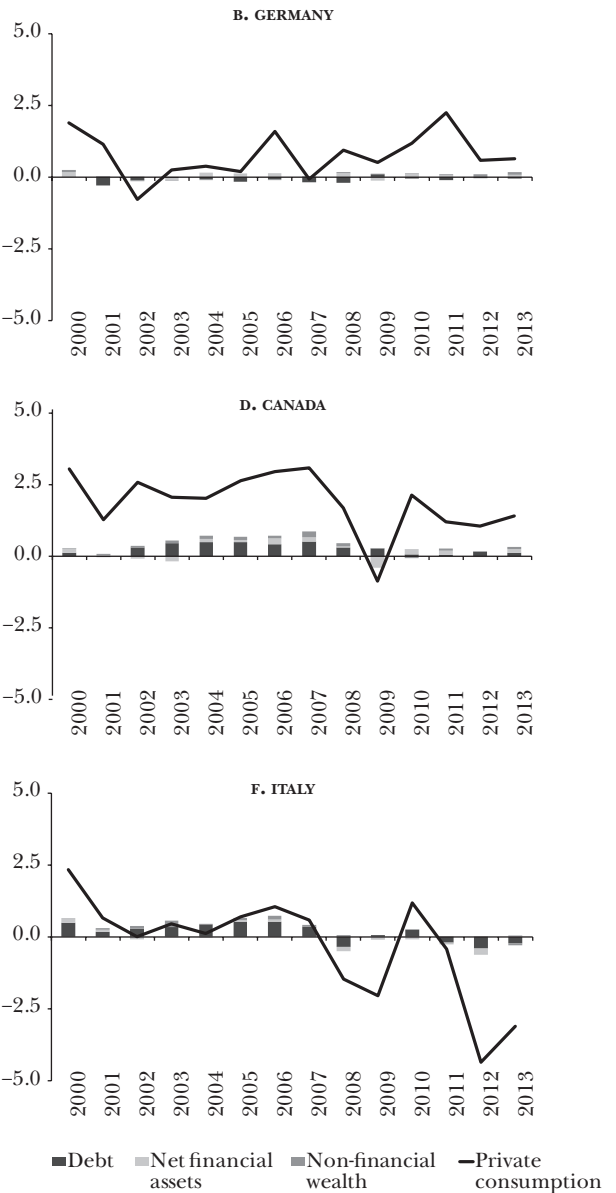
PRIVATE CONSUMPTION GROWTH (PER CAPITA) AND THE CONTRIBUTION OF THE DIFFERENT COMPONENTS OF HOUSEHOLD WEALTH: EXAMPLES



Source: Own calculations.

Figure 5 (cont.)

PRIVATE CONSUMPTION GROWTH (PER CAPITA) AND THE CONTRIBUTION OF THE DIFFERENT COMPONENTS OF HOUSEHOLD WEALTH: EXAMPLES



Source: Own calculations.

a moderate drag on its consumption rate, fully compensated by the increase in net financial assets. By contrast, debt accumulation by US households jointly with the stock market recovery after the dotcom bubble burst and house price increases allowed them to support consumption growth. After 2008, deleveraging and assets price adjustments represented a drag to US consumption growth, although the situation was reversed by 2013. On the contrary, it seems that in Germany debt has not influenced private consumption growth after the financial crisis.

The intermediate panels of Figure 5 analyze the situation of the Netherlands and Canada. Both countries have shown an increase in indebtedness after the Great Recession, but the consumption pattern has been radically different. The Netherlands is characterized by a high indebtedness ratio (more than 250% in 2008); in Canada it was below 150% at that time. Both economies continued increasing indebtedness during the recovery period. The behavior of private consumption in these economies has been radically different both before and after the crisis. In the Netherlands, the increase in debt sustained the moderate increase in consumption before the Great Recession; afterward the high debt level represented a drag for consumption. In Canada, the contribution of debt has been positive in all the sample period, although diminishing after the crisis; anyway, indebtedness has played a minor role.

Finally, Spain and Italy are two other interesting examples (final panels of Figure 5) since they show a similar consumption pattern after the crisis. Indebtedness in Spain almost doubled that of Italy before the crisis and the increase was also higher. After the crisis, Spain has deleveraged while Italy increased the debt ratio with a decelerating path. In both countries indebtedness played an important role to explain private consumption before 2008, more important in the case of Italy. Afterward, in both countries the debt level has been a drag, more relevant in Spain.

4. ROBUSTNESS: THE PRESENCE OF NON-RICARDIAN EFFECTS

The existence of credit constraints and uncertainty may also cause the appearance of non-Ricardian effects when considering government decisions. And the recent unprecedented increase in public debt during the financial crisis may have been a very relevant factor for consumption dynamics.

Given the sovereign debt crisis in the euro area after 2010 we have decided to consider the spreads of long term interest rates (with respect to a world GDP weighted average) in our regression analysis instead of the most traditional approach of including the public debt or the fiscal balance (see, for example, Mody et al., 2012). We prefer this variable as it is probably a more comprehensive measure of all the burdens (observed and contingent) public finances could support in the short and long run. Besides, this is an indirect way to check for the influence of an additional credit constrains factor in consumption given the severe sustainability problems in public debt in some advanced economies. For those countries, markets may require a higher interest rate to finance public and private activities. For example, in the euro area bank lending rates became very heterogeneous across certain countries after the sovereign debt crisis.

Thus, as a robustness exercise, we want to see if the previous credit-channel and uncertainty factors survive in the presence of another financial factor as it is a high public debt ratio. Table 3, columns 1 and 2 once we consider the disaggregated net financial wealth effect, check whether the interest rate spread has a strong influence on private consumption. According to the hypothesis that deficit finance affects current household behavior, we would expect consumption to respond negatively to an increase (observed or contingent) in the public debt ratio. Such a response would be consistent with a negative impact of the sovereign spread. As this variable is included jointly with the real interest rate, this channel is not contaminated by a substitution effect. When the regression is estimated by OLS

Table 3

ESTIMATION OF THE CONSUMPTION FUNCTION: NON-RICARDIAN EFFECTS

Dependent variable: consumption growth per capita. Country and time fixed effects

	(1)	*(2)*	*(3)*	*(4)*
	OLS	*IV*	*OLS*	*IV*
Constant	0.014[c]	–0.001	0.012[c]	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Consumption growth (–1)	0.166[b]	0.237[c]	0.080[b]	0.144[c]
	(0.072)	(0.050)	(0.034)	(0.050)
Income growth	0.296[c]	0.177	0.247[c]	0.262[b]
	(0.032)	(0.141)	(0.029)	(0.132)
Income growth expectations	0.047[c]	0.027	0.035[c]	0.009
	(0.006)	(0.022)	(0.005)	(0.020)
Change in the Gini index (–1)	–0.163[b]	–0.186[b]	–0.130[b]	–0.140[a]
	(0.072)	(0.078)	(0.065)	(0.072)
Net financial assets growth (–1)	0.025[c]	0.030[c]	0.017[c]	0.020[c]
	(0.006)	(0.007)	(0.006)	(0.007)
Housing wealth growth (–1)	0.037[c]	0.046[c]	0.019	0.026[a]
	(0.013)	(0.015)	(0.012)	(0.014)
Housing wealth growth (–2)	–0.027[b]	–0.020	–0.015	–0.010
	(0.012)	(0.013)	(0.011)	(0.012)
Real interest rate change (–1)	–0.102[b]	–0.144[c]	–0.079[b]	–0.102[b]
	(0.041)	(0.054)	(0.037)	(0.050)
Households debt growth	-	-	0.135[c]	0.098[c]
			(0.013)	(0.030)
Households debt growth (–2)	-	-	–0.039[c]	–0.044[c]
			(0.012)	(0.014)
Changes in uncertainty	-	-	–0.010[c]	–0.011[c]
			(0.002)	(0.002)
Sovereign spread changes	–0.293[c]	–0.343[a]	–0.172[c]	–0.196
	(0.064)	(0.202)	(0.059)	(0.195)
Error correction mechanism	–0.059[c]	–0.067[c]	–0.056[c]	–0.078[c]
	(0.014)	(0.023)	(0.013)	(0.021)
R^2	0.689	0.672	0.749	0.731
Standard deviation×100	1.276	1.356	1.147	1.208
Durbin-Watson	1.895	1.911	1.860	1.909
Sargan test	-	20.898	-	21.487
		[0.231]		[0.205]
Number of observations	642	601	642	601

Notes: Standard deviations in round brackets; *p*-values in square brackets; [a], [b] and [c] significant at 10%, 5% and 1%, respectively. Instruments: Variables lagged two to three periods plus dependency ratio contemporaneous and lagged one period and financial liberalization index lagged one and two periods.

the sovereign spread is negatively signed and very significant. However, when it is instrumented, the statistically significance drops substantially, to 9%. Compared to the results in column 4 of Table 1B, the most significant change in the other coefficients is that of the real interest rate, that now is higher in absolute terms, becoming significant at 90%. Columns 3 and 4 of Table 3 add the other financial factors considered in previous section: Household's debt and uncertainty. Again the sovereign spread is negatively signed but it losses all statistical relevance. Other checks with a different set of instruments did not provide favorable results. As a consequence, this could imply that non-Ricardian effects identified elsewhere could be the consequence of the presence of more general credit constrains effects. In fact, when we added public debt in the specification including household's debt and uncertainty it was also not significant.

5. CONSUMPTION 2008-2013: A COUNTRY COMPARISON

This section makes a cross-country comparison of the determinants of consumption between 2008 and 2013 using the previously estimated behavioral equations. We are interested in an assessment of the countries for which the non-traditional determinants may be more relevant. In particular, we are interested first, in the relevance of the increase of household debt level before 2007 and the debt deleveraging afterward for dampening consumption behavior in the most recent period, and second, on how the increase in labor income uncertainty has also influenced that behavior.

Figure 6 analyzes the determinants of (per capita) consumption growth in the period 2008-2013 taking as a benchmark the estimated equation that takes into account both financial factors (Table 2, column 6). The countries are grouped according to their average growth in consumption during that period.

Korea showed the highest increase in consumption in this sample whereas Spain, followed by Ireland, experienced the

largest decline. The bars represent the estimated annual average private consumption growth rate during the period 2008-2013. These bars are divided into the contribution from the traditional determinants (country fixed effects, inertia, income, expected income, Gini index, disaggregated wealth, interest rate and error correction mechanism), changes in uncertainty and household debt growth (the sum of the contemporaneous and the lagged effects). All these factors add to the estimated value (the white bullet) that may be compared with the observed value (the black diamond).

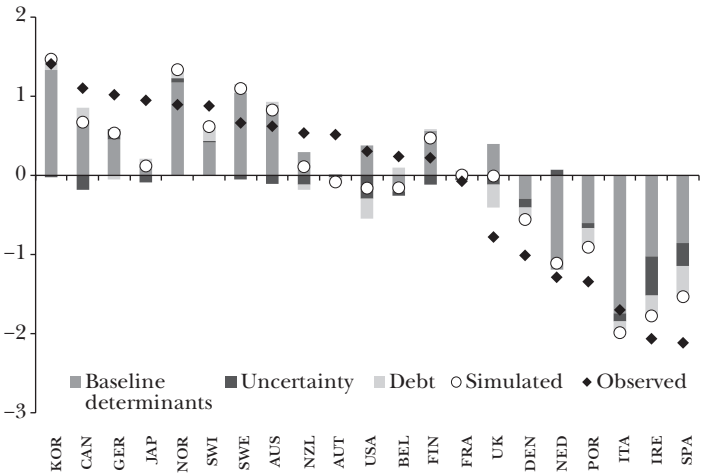
The equation seems to capture relatively well the changes in private consumption during the recession. It successfully predicts the sign of the average growth rate in most countries, and the residuals are relatively low. On average, the traditional determinants of private consumption are the major explanatory factors of its behavior during the recession.

The two additional financial factors considered in the paper also play a relevant role in constraining consumption in some countries and their effect seems more relevant in countries where consumption fell. For example, in the countries reducing debt in this period (USA, UK, ESP, POR, ITA, IRL, GER, DEN and AUS) it explains an average reduction of around 0.2% in per capita private consumption out of an average decline of 0.8%. For the US economy, its recent favorable recovery explains that though past deleverage process still weighs negatively on consumption it has recorded a positive average growth figure since 2008.

Finally, the contribution of uncertainty is of a minor order, except in countries like Ireland and Spain (and to a less extent USA and Canada). For these two countries the variability of unemployment explains an average decline of per capita private consumption of 0.4%, out of the 2.1% reduction observed. However, in specific periods it could be very important for all countries. For example, in the period 2007-2009 the aggregate saving ratio of this sample of countries increased by 2.3 percentage points, of which one percentual point (40%) is explained by the variability in unemployment. This effect

Figure 6

CONTRIBUTORY FACTORS TO THE PRIVATE CONSUMPTION GROWTH RATE AFTER THE FINANCIAL CRISIS (2008-2013)



Source: Own calculations.

is in the lower part of the range encountered by Mody et al. (2012), who estimate that at least two-fifths of the increase in saving in this period in the OECD countries can be attributed to unemployment risk and the GDP volatility.

6. CONCLUSIONS AND FUTURE RESEARCH

The empirical literature on consumption behavior has emphasized the importance of financial innovation and deregulation to explain the shifts in wealth and credit conditions for understanding the boom in consumption preceding the crisis and the weakness in the recovery period. And recently, some authors have mentioned that *debt overhang* linked especially to the mortgage developments in some advanced economies, may have an independent role beside more traditional financial factors in explaining this weakness in consumption.

This paper has presented the first cross-country evidence of the importance of the household balance-sheet composition to explain the slow recovery of consumption after 2008. Using the panel data of 21 OECD countries from 1980 to 2013 we estimated a traditional dynamic consumption equation that considers wealth composition and the standard effect of income (observed and expected) and interest rates. Once we take into account the endogeneity, there are relevant effects of both financial assets and housing stocks, reinforcing the influence of credit conditions on consumption through the housing market.

Moreover, we find a better specification when unemployment volatility and household debt dynamics are considered additional determinants. Both a positive leverage effect and a negative debt overhang effect are significant explaining per capita consumption growth. This debt dynamics' significance is consistent with the perceived changes in the credit constraints and the overestimation of housing wealth effects when that is not taken into account in aggregate consumption equations. And uncertainty is crucial in explaining the saving behavior of households, especially at the turning points of the cycle (2007-2009). Overall these results highlight the relevance of uncertainty capturing the precautionary savings effect and the balance-sheet composition measuring households' financial soundness.

Looking at the balance sheet's relevance across sectors, we measure the possible public debt effect through the changes in the long term interest rate spread. That does not have a significant effect on private consumption once we take into account the household's debt dynamics. Therefore, it seems that non-Ricardian effects do not seem relevant once a general credit constrain effect is considered.

Our findings imply that deleveraging in countries like the USA, the UK or Spain after 2008 explains around 25% of the drop observed in consumption. Furthermore, the uncertainty arising from the increase in unemployment in some European countries (Spain and Ireland) has been an additional factor which explains their consumption dynamics relative to other

OECD countries. The increase in uncertainty is also crucial to explain savings in all countries in specific periods; in particular, 40% of the increase in savings in this sample of countries between 2007 and 2009 can be explained by the increase in uncertainty.

However, more robustness exercises are needed to understand the interaction of aggregated consumption and financial variables before we extract policy implications or try to anticipate the expected movement of household spending in future. Note that current macroeconomic policies, such as fiscal transfers to favor household debt restructuring or cuts in interest rates to historic lows, are influencing the aggregate household debt reduction and the household cash flow and they are relevant counterweights of consumption dynamics. Similarly, restructuring of financial institutions in some countries is affecting credit conditions. Thus, it is relevant to analyze how that specific set of policies may have affected the consumption dynamics of certain countries. From a technical perspective, we leave for further research higher dimensional frameworks, like panel VAR, which could consider the joint adjustment of debt and consumption to financial and real disturbances.

Appendix 1

The Dataset[10]

The 21 OECD countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

- Real consumption: Obtained from the OECD database and Datastream.

[10] The full data set is available upon request.

- Population: OECD.
- Nominal consumption: Obtained from the OECD, Datastream and national statistical sources.
- Gross disposable income: OECD.
- Consumer confidence (income growth expectations): Obtained from the OECD and national statistical sources.
- Gini Index: The Standardized World Income Inequality Database and the OECD.
- Financial assets: Obtained from the OECD, enlarged by the year-on-year growth rate of Stock Exchange Index, adjusted by the regression coefficient between both variables, at country-level.
- Household debt: See previous variable. Missing values were generated with information from bank credit.
- Non-financial wealth: defined as real housing stock times housing prices. The initial condition for real fixed capital stock is obtained from the EU-KLEMS database, if available. For the other countries, the initial condition is calculated dividing real housing investment (obtained from the OECD and AMECO) in 1980 by a country specific estimated ratio between real housing investment and real housing stock. This estimated ratio depends on per capita GDP at PPP in 1980, from the IMF. The depreciation rate of the housing stock is estimated at 2% per year. Finally, housing prices are obtained from the International House Price Database, provided by the Federal Reserve Bank of Dallas.
- Long term interest rate: Obtained from the OECD, Datastream and AMECO database. It corresponds to that of 10-year government debt yields.

- Long term interest rate spread: Difference between the long-term interest rate for each country and the world one, obtained as the PPP-weighted average of the corresponding interest rates of this sample of countries.
- Unemployment: Obtained from OECD and Datastream.

Table A.1

SUMMARY STATISTICS OF THE VARIABLES

	Mean	*Standard deviation*	*Min*	*Max*
Per capita real consumption growth rate	0.016	0.024	–0.141	0.105
Per capita real disposable income growth rate	0.013	0.014	–0.116	0.127
Consumption over disposable income	0.891	0.067	0.675	1.064
Gini index	0.288	0.043	0.197	0.375
Financial assets over disposable income	3.198	1.703	0.201	22.385
Non-financial wealth over disposable income	2.226	1.049	0.615	8.777
Debt over disposable income	1.005	0.550	0.133	3.191
Real interest rate	0.038	0.025	–0.048	0.216
Interest rate spread	0.010	0.029	–0.079	0.201
Uncertainty (standard deviation of the change in the unemployment rate)	0.768	0.526	0.042	3.436

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A Review of the Financial Regulatory Framework of Barbados

Abstract

It is well established in the literature that the financial system plays a pivotal role in the development process. Thus, it is incumbent on governments to have strong and effective regulatory regimes in place to protect investors, ensure orderly functioning of financial institutions and markets, and maintain confidence and stability in the financial system. An area of regulation receiving renewed attention in recent times is the institutional structure of financial regulation; specifically, whether the existing institutional arrangements for regulation are resulting in comprehensive and effective regulation of the financial system. These discussions have been driven to a large extent by changes in the structure of the financial services industry globally and the disruption to financial systems in many countries.

While the type of institutional structure may not be the main determinant of regulatory effectiveness, an inappropriate or outmoded structure can impede the attainment of regulatory and supervisory goals. The aim of this paper is to examine the adequacy of the financial regulatory framework in Barbados. Specifically, the paper seeks to determine whether the current architecture of financial regulation provides suitable coverage of all areas of regulation, and whether the

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Central Bank's responsibility for prudential regulation and monetary policy is appropriate and in keeping with best practice. Data were obtained via an interview survey with managerial personnel of the regulators (Central Bank of Barbados, Financial Services Commission and Fair Trading Commission) and selected financial institutions during the period July to September 2014. The research findings reveal that though an integrated regulator would benefit the Barbadian financial system, it is not necessary as the current system is adequate. However, the lines of responsibility for certain aspects of regulation by the three agencies should be better delineated. Also, the Central Bank should maintain responsibility for monetary policy and prudential regulation.

Keywords: Barbados, central bank, Fair Trading Commission, Financial Services Commission, financial regulation, financial system, regulatory framework.

JEL classification: G10, G18, G28.

1. INTRODUCTION

It is well established in the literature that the financial system plays a pivotal role in the development process. In the course of financial activity, the savings of the economy are increased and rendered highly mobile, and the risk facing savers are reduced through diversification. Also, the financial system contributes to economic growth by enhancing the volume and productivity of investment activities. By assessing which managers and which projects are likely to be the most profitable and monitoring the behavior of borrowers, financial intermediaries ensure that resources are used efficiently (Wood, 2012).

Given the critical role of the financial system in a country's development, it is incumbent on governments to have strong and effective regulatory regimes in place to protect investors, ensure orderly functioning of financial institutions and markets, and maintain confidence and stability in the financial system. This imperative was once again brought into sharp focus by the latest financial crisis which had devastating consequences for companies and governments worldwide. In a crisis

situation confidence in the financial system is undermined and there is a reduction of credit to firms and individuals which in turn leads to a contraction in economic activity.

An area of regulation receiving renewed attention in recent times is the institutional structure of financial regulation; specifically, whether the existing institutional arrangements for regulation are resulting in comprehensive and effective regulation of the financial system. These discussions have been driven to a large extent by changes in the structure of the financial services industry globally and the disruption to financial systems in many countries. Notable examples are the financial crisis originating in the United States of America in the late 2007 which, through contagion, affected several countries and financial systems across the globe, and in the Caribbean the failure of Colonial Life Insurance Company Group which had disastrous consequences for investors, policyholders and governments in the region. In many jurisdictions the traditional distinction between the activities of different types of financial institutions has faded. Hence, the previous division of regulators based predominantly on institution type is now being relooked. Indeed, some countries have established a single regulator for the entire system while others have opted for a regime with regulators based on the regulatory objectives they seek to achieve.

While the type of institutional structure may not be the main determinant of regulatory effectiveness, an inappropriate or outmoded structure can impede the attainment of regulatory and supervisory goals. Institutional structure may have an impact on the overall effectiveness of regulation and supervision because of the expertise, experience and culture that develop within particular regulatory agencies and the approaches they adopt (Llewellyn, 2004). The aim of this paper is to examine the adequacy of the financial regulatory framework in Barbados. Specifically, the paper seeks to determine whether the current architecture of financial regulation provides suitable coverage of all areas of regulation and whether the Central Bank's responsibility for prudential regulation and

monetary policy is appropriate and in keeping with best practice. The paper extends the Caribbean literature on financial regulation which focuses mainly on describing the regulatory frameworks (Williams, 1988; Feracho and Samuel, 1997; Nicholls and Seerattan, 2004).

Data were obtained via an interview survey with managerial personnel of the regulators (Central Bank of Barbados, Financial Services Commission and Fair Trading Commission) and selected regulated financial institutions during the period of July to September 2014.

The remainder of the paper is organized in the following way: Section 2 reviews the relevant literature on financial regulation; Section 3 provides an overview of the Barbadian financial regulatory framework; the methodology is discussed in Section 4; the findings are presented in Section 5 while the discussion of the findings is the focus of Section 6; and a concluding summary is provided in the final section.

2. LITERATURE REVIEW

2.1 Why Financial Regulation?

The idea of mandatory regulating something suggests a need to control it, have it conform to standardized norms and comply with rules within a particular framework. Financial regulation involves government intervention in the financial system through the passage of rules and laws, and the establishment of institutional arrangements to deal with enforcement, monitoring and supervision. It is generally acknowledged that the financial system is more heavily regulated than other areas of the economy. This situation arises from the special nature of the activities undertaken by financial institutions and the vital role of the financial system in the development process.

Wood (2012) discusses the important functions performed by the financial system. First, through economies of scale in the collection of information and portfolio management, financial intermediaries transmutate the financial claims flowing

from borrowers to lenders in order to satisfy simultaneously the portfolio preferences of both economic agents (Gurley and Shaw, 1956, 1960). Through the intermediation process transaction costs are reduced and there is greater diversification of risk than is achievable under direct finance. Thus, financial intermediaries contribute significantly to an increase in investment activities and, hence, growth. Second, financial intermediaries may serve as leading agents in development by identifying entrepreneurs with the potentially most profitable ideas and products, and supplying finance to these projects (King and Levine, 1993; Drzeniek-Hanouz et al., 2009). Third, financial intermediaries facilitate a more efficient allocation of resources through their ability to overcome informational problems in financial markets (Diamond, 1984; Mayer, 1988). Fourth, financial institutions may serve as a disciplinary device on management, thereby incentivizing managers to pursue policies to improve the financial performance of firms (Jensen, 1986 and 1988; Sheard, 1989; Aoki and Patrick, 1994). Further, financial intermediaries may play an important role in the reallocation of assets through corporate restructurings. Fifth, the financial system facilitates trade through the provision of credit and guaranteeing payments. Finally, financial institutions provide specialized services, for example, brokerage, insurance, property management, underwriting and other financial services.

In the performance of these important functions, financial institutions are open to varying types of risk (for example, credit risk, default risk, interest rate risk, market risk, liquidity risk, operational risk, reputational risk) which, if not efficiently managed, could be detrimental to the financial health of the institutions and could undermine confidence and stability in the entire financial system. Also, because of the inextricable link between finance and real development, other sectors within the economy are affected when financial institutions fail. As noted by the Warwick Commission (2009, p. 9) "when financial markets malfunction, the real economy takes a nose-dive."

Given the crucial role of the financial system in the growth process and the risks inherent in the intermediation process, governments have consistently intervened to regulate and control the activities of financial institutions. The standard rationale for government intervention in the financial sector is the problem of market failure, that is, the market would produce a suboptimal outcome if left to itself. Several reasons have been identified for market failure in the financial sector including asymmetric information or information inadequacies, moral hazard and externalities of financial disruptions. Asymmetric information relates to the situation where investors have limited information about the products sold by financial institutions and as a result can be disadvantaged by financial institutions at the time of purchase. Moral hazard relates to the situation where management of the financial institution takes on riskier than normal activities once the investor purchases the product. The moral hazard problem may be exacerbated with a deposit insurance scheme which guarantees investors recovery of some percentage of their funds should the financial institution experience difficulty. Externalties of financial disruptions or social externalities relate to the situation where the failure of a financial institution (or subset of institutions) has a negative effect on other financial institutions and, in severe cases, may lead to a collapse of the financial system. Also, because of the nexus between finance and real development, problems in the financial sector are likely to have devastating consequences on the entire economy.

The above discussion indicates that the major objectives of government intervention in the financial sector are the protection of investors, ensuring orderly functioning of financial institutions and promoting financial stability. Other reasons identified by Pilbeam (1998, p. 368) are to promote fair and healthy competition to ensure competitive prices for consumers and the government's desire to exert some degree of control over the level of economic activity, particularly in relation to monetary policy.

2.2 Types of Regulatory Measures

Financial systems worldwide are subject to several types of regulatory measures which vary by levels of complexity and scope depending on the state of development of the country's financial system and the differing cultural, economic and political systems.

The literature identifies the following types or categories of financial regulation: Structural, monetary, prudential, code-of-conduct/consumer protection and competition. Structural regulation sets the general parameters for the financial institutions; it refers to the types of activities, products and geographical boundaries within which financial institutions can operate. Monetary regulation, sometimes termed macro-monetary regulation, refers to the use of monetary policy tools to bring about predetermined macroeconomic outcomes. Traditional instruments of monetary policy include open-market operations, cash reserve requirements, interest rate controls and discount rate.

Prudential regulation focuses on the safety and soundness of financial institutions. This type of regulation emphasizes the control of risk through mainly capital requirements, limits on customer concentration and risk-based portfolio assessment (Williams, 1996). Prudential regulation is further divided into micro and macroprudential regulation. Microprudential regulation focuses on the health of individual institutions whereas macroprudential regulation refers to the use of prudential tools with the explicit objective of promoting the stability of the financial system as a whole. Macroprudential regulation may therefore be considered systemic regulation where the focus is on the externalities from financial disruptions.

Immediately after the financial crisis, a widespread consensus emerged among policymakers and academics that a new macro approach to prudential regulation aimed at containing externalities was needed to stabilize the economy going forward (Glavan and Anghel, 2013). Specifically, the regulatory measures should address issues relating to the underestimation of

risk during economic booms and overestimation during economic recessions, the procyclicality phenomenon discussed by the Warwick Commission (2009) and Mishkin and Eakins (2012), among others. This would ensure that financial institutions, mainly banks, invest more capital than they would generally consider necessary in boom periods so they can support credit during crash periods by releasing this capital. Such activities would narrow the gap between economic boom and crash periods and, hence, achieve greater economic stabilization.

Consumer protection regulation is focused on conduct-of-business arrangements designed to protect the consumer from factors such as incomplete information, bad practices by financial firms and unfair practices (Llewellyn, 2004). This type of regulation requires setting and enforcing the appropriate rules under a transparent legal framework. It is not the simplest task for the ordinary consumer to understand the details of financial products and, hence, can be disadvantaged in their transactions with financial institutions. Woolward (2013) notes that many financial firms add layers of complexity via impenetrable jargon, pages of terms and conditions, bizarre exclusions in the reams of small print, and products launched and withdrawn with often bewildering frequency. However, regulations that consider the interest of consumers, with regards to making financial terms more customer-friendly and having the financial institutions being more transparent, fair and accountable for their actions, will help to ensure that customers are protected against discriminatory and unfair practices by the institutions (Jordan, 2015).

Competition regulation is designed to ensure that there is an appropriate degree of competition in the financial system and that anticompetitive practices by financial firms are eliminated. This type of regulation is necessary to prevent ineffective competition from leading to poor outcomes for consumers. Competition regulation involves analyzing markets from all angles and seeking to understand the interactions between both demand and supply-side competition weaknesses. The

regulator then uses his powers to improve the effectiveness of competition.

2.3 Regulatory Structures

The Group of Thirty (2008) and Fresh and Baily (2009) identify four main types of structures: The *twin peaks model*, the *functional approach*, the *institutional approach* and the *integrated approach*.

The Twin Peaks Model

The twin peaks model relies on two types of regulators: A prudential regulator and a conduct-of-business (consumer protection) regulator. Although defined as separate entities, these two regulators generally employ a high level of coordination since they are each responsible for overseeing the operations of different aspects of the same institutions. The twin peaks model is generally considered, like the integrated approach, to offer the type of flexibility needed to deal with rapid innovation in the financial sector and the blurring of lines between what were once considered the traditional actors in finance.

The Functional Approach

The functional approach seeks to regulate financial institutions based on the type of business they undertake, with disregard for how a given institution is defined legally. Therefore, various branches of the same institution could be under the purview of different regulators as a result of the business that they conduct. For example, a bank, which as part of its business model also offers securities services, would have to report to two regulators, the banking regulator and the securities regulator. For the functional approach to operate most effectively, a great deal of coordination is required among the various functional regulators to ensure that no branch of a given institution escapes oversight.

The Institutional Approach

Under an institutional approach, the legal status of an institution determines its regulatory supervision. In this case, once an institution is licensed as a bank, it is regulated by the banking supervisor though it may also be lawfully conducting securities business. The institutional approach is one of the least flexible, proving difficult to adapt to the blurring lines between types of financial institutions. Despite a given legal status, many financial institutions have engaged in increasingly broad operations outside of the relatively narrowly-defined confines of that status. Furthermore, shifting their legal status allows institutions to engage in regulatory arbitrage.

The Integrated Approach

In an integrated approach, a single regulator oversees all types of financial institutions and provides both prudential regulation as well as conduct-of-business (consumer protection) regulation. Llewellyn (2004) does not, however, consider the mix of conduct-of-business regulation and prudential regulation as the integrated approach; he considers this a mega regulator, a more drastic level of integration.

Few countries have a model that fits neatly into any one of the above approaches. Most developed countries such as the United Kingdom, Switzerland, Canada and Australia have adopted a twin peaks system. On the other hand, the United States of America appears to have an institutional approach with multiple regulators for one type of financial institution. Singapore, Trinidad and Tobago, and Cayman Islands exhibit traits of a mega or integrated system as there is one combined regulator with a mandate for all types of regulation.

It should be noted that several regulatory arrangements are possible whereby the single or multiple regulators can function while ensuring appropriate coordination, sharing of facilities, and, where appropriate, establishing clear-cut responsibilities. These arrangements may include establishing an oversight board over the multi-regulatory structure, unifying the

support systems while leaving the regulators separate and establishing a memorandum of understanding (MOU) among all of the regulators, thereby reducing issues relating to accountability, transparency and information exchange.

2.4 The Role of the Central Bank

Another important factor that must be considered when contemplating changing the regulatory structure is the role of the central bank. More specifically, to what degree should the central bank, with responsibility for monetary (macro-monetary) regulation, be involved in prudential regulation? There are three main issues which must be considered in determining the central bank's role: The interaction between financial stability and prudential supervision, the concentration of power and the independence of the central bank.

One school of thought espouses that the central bank is well placed to perform the dual role of monetary and prudential regulator. Schoenmaker (2013) supports this view on the grounds that the objectives of financial stability and prudential supervision are two sides of the same coin since disruptions in the financial system have an impact on the real economy, with related effects on output and inflation.

Combining the responsibilities for monetary policy and prudential regulation can also be advantageous in crisis management arrangements. For example, in the United Kingdom, the memorandum of understanding between the Bank of England and the Financial Services Authority gave the Bank of England lender of last resort responsibility while the Financial Services Authority had responsibility for the conduct of operations in response to problem cases affecting firms, markets, and clearing and settlement systems within its purview. When the bank run on Northern Rock occurred in September 2007 the authorities were criticized for failing to respond sufficiently promptly to avert the run on the bank. This led to a revival of the argument that the central bank should also be the bank supervisor, since it is very difficult for the lender of

last resort to act promptly when the agency with the knowledge of a particular failing bank is not the same agency responsible for extending credit (Taylor, 2013). The authorities' response in the United Kingdom was to unify the Financial Services Authority with the Bank of England.

Further support for combining central banking with prudential supervision focuses on the positive synergies between the macroeconomic and microeconomic goals. The close relations with banks, through bank supervision, will assist the central bank in anticipating the direction of the economy and in addressing financial crises. Intimate knowledge of banks will prevent inappropriate access to lender of last resort lending. Also, responsibility for bank supervision enables the central bank to protect the payments system from the risk of contagion (Schooner and Taylor, 2010).

The argument for the dual role of the central bank must be balanced against the concern about concentration of power. Some of the normal checks against the abuse of regulatory power might be relaxed when the regulatory function is combined with other powers. For example, a bank might be reluctant to challenge regulatory actions (anything from proposed rulemaking to an enforcement action) for fear that the central bank might retaliate by limiting its access to liquidity support in times of need (Taylor, 2013). In addition, the central bank may suffer loss of credibility if it performs poorly as a bank supervisor, which could compromise its effectiveness in implementing monetary policy.

However, in developing countries such concentration may prove beneficial. The stature of the central bank may be necessary to compel change in the culture of regulation. The central bank may be a necessary force behind a nascent supervisory regime. Indeed, The World Bank's Bank Regulation and Supervision Survey 2012 notes that in more than 60% of jurisdictions, central banks are the agencies that supervise commercial banks for prudential purposes.

Independence of central banks is generally considered desirable with respect to monetary policy. There is also a trend

to require regulatory and supervisory independence; hence, if the supervisory role is performed by the central bank, it is assumed that the independence the central bank has over its monetary policy function will also apply to its prudential function. In many emerging market economies, the central bank possesses a degree of prestige and independence not enjoyed by a regulatory agency under a wing of a government ministry. This allows the central bank to pursue a forceful regulatory policy free from political interference. However, the type of independence that is necessary for the central bank's macroprudential function may not be appropriate for microprudential regulation since microprudential regulation has the potential to impact on individual rights (for example, those of shareholders). Therefore, the bank supervisor must be limited by the checks and balances provided by judicial review and political accountability (Schooner and Taylor, 2010).

In practice, no bank regulator could, or should, ever be totally independent of the central bank. The central bank is the monopoly provider of the reserve base and the lender of last resort. Moreover, the central bank, in its macro policy operational role, must have a direct concern with the payments and settlements system, the money markets and the development of monetary aggregates. Thus, there are bound to be, and must be, very close relations between the bank regulator and the monetary policy authority.

3. OVERVIEW OF THE BARBADIAN FINANCIAL REGULATORY FRAMEWORK

In order to determine whether the Barbadian financial system would benefit from a consolidated regulator and to opine on the role of the central bank, the current structure of the regulatory system must be understood.

The Barbadian financial system comprises the central bank, commercial banks, merchant banks, finance companies, trust companies, credit unions, insurance companies, financial asset management firms (mutual funds), financial brokerage

firms and a stock exchange. These institutions operate mainly in money, credit, equity, bond, and foreign exchange markets; and are both of domestic and international ownership (Howard, 2013). The July 2014 Central Bank of Barbados Financial Stability Report indicates that assets in the financial system as at March 2014 were estimated to be in the region of 21 billion of Barbadian dollar (BBD) or 250% of the gross domestic product. Commercial banks dominate the financial system, accounting for 59% of total assets, followed by insurance companies with 17%, mutual funds with 9%, credit unions with 8% and finance companies with 7 percent.

The regulatory framework in Barbados is currently structured to give coverage to every financial institution. The main regulators are the Central Bank of Barbados (CBB), the Financial Services Commission (FSC) and the Fair Trading Commission (FTC). The CBB was established by the Central Bank of Barbados Act 1972 and commenced operations with the pivotal central banking mandate to safeguard and ensure monetary and financial stability, while seeking to promote economic development. Other important roles performed by the CBB include maintaining the external reserves to safeguard the external value of the Barbadian dollar, administering the country's exchange control regulations, issuing and making a market for government securities, acting as a banker to government and commercial banks, and providing advice to Government (Wood, 2012).

Within its mandate for prudential regulation the CBB monitors the operations of commercial banks, finance companies, trust companies, merchant banks and mortgage finance companies on the basis of the Financial Institutions Act 1997. In addition, it has responsibility for the regulation of international or offshore banks on the basis of the International Financial Services Act 2002. The CBB effects supervision of the financial institutions under its charge through the Bank Supervision Department and the Research Department which houses the Financial Stability Unit. The Bank Supervision Department is responsible for microprudential regulation and the Research

Department for macroprudential regulation. The Bank Supervision Department is divided into three sections: The policy section which has responsibility for producing guidelines, amending legislation and developing prudential reporting norms; the approvals section which is responsible for approving new applications and applications to change business models; and the supervision section which focuses on reviewing data submitted and conducting onsite inspections. The Research Department monitors the impact of macroeconomic developments on the financial system and monetary policy impacts and, through the Financial Stability Unit, conducts stress tests on individual banks and the entire financial system.

Other departments within the CBB play important supportive roles. The Banking, Currency and Investments Department monitors interbank activity and performs the lender of last resort function of the CBB, and the Foreign Exchange and Exchange Control Department monitors all external capital flows and is, therefore, constantly kept abreast of the external transactions of financial institutions (Howard, 2013).

The Financial Services Commission was established by the Financial Services Act of 2010 and commenced operations in April 2011. The FSC is responsible for the regulation of the non-banking financial services sector. The creation of this regulatory body represents a significant development in the evolution of Barbados' regulatory framework since it is an amalgamation of the regulators of non-bank financial institutions (Wilson, 2011). These agencies are the Supervisor of Insurance which regulates the operations of insurance companies, the Department of Cooperatives which regulates credit unions and the Securities Commission which is responsible for the Barbados Stock Exchange and its market participants. The FSC has seven divisions: Securities, credit unions, insurance, pensions, registration and licensing, research and examinations. The examinations division deals with onsite inspections of all entities under the purview of the FSC.

The Fair Trading Commission was established in January 2001 through the Fair Trading Commission Act. The duties of

the FTC include determining principles, rates and standards for regulated service providers; monitoring general business conduct; investigating possible breaches of the Acts administered by the FTC; educating and informing businesses and consumers about the requirements of these Acts; and taking enforcement action when needed. With regard to the financial sector, the FTC's focus is on conduct-of-business (consumer protection) regulation and competition regulation. The FTC has three divisions: Fair competition division, consumer protection division and utility regulation division. The sections are not further broken down by industry since the size of Barbados does not allow for such a level of specialization.

4. METHODOLOGY

The main purpose of the research is to review the financial regulatory framework of Barbados to determine whether the current structure of financial regulation provides suitable coverage of all areas of regulation and whether the Central Bank of Barbados' responsibility for monetary and prudential regulation is appropriate.

Data were obtained via structured interviews with managerial personnel of the regulators and selected financial institutions during the period July to September 2014. This approach was preferred over self-administered questionnaires for the following reasons. The interviewer can explain questions that the respondent has not properly understood and there is the opportunity to probe respondents to elaborate on answers (Seale et al., 2011). Hence, the interviewer can pursue in-depth information around the topic. However, we should note that interviews may be subjected to the influence of the interviewer (Bryman, 2012).

Two triangulation methods were used to validate the research findings: Data triangulation and methodological triangulation. Data triangulation involves the use of different sources of information. Potter (1996) asserts that a researcher whose findings are derived from many sources will be more

convincing than another researcher whose conclusions are based on observations from one source. To effect data triangulation the views of the key stakeholders in the financial sector (the regulators and the regulated institutions) were sought. Methodological triangulation is the use of multiple research methods to study a phenomenon. Methodological triangulation was effected by combining document review with the interview technique. The documents reviewed include regulators' websites and published literature in the area.

Two general instruments were developed to capture information from the targeted categories of participants.[1] The questions to the regulators cover areas such as the purpose of the organization, the organization's interaction with other regulators, the entity's coverage of various areas of regulation, principles guiding the supervisory approach and the response to the possibility of a unified regulator. The questions to the regulated institutions cover areas such as the similarity in products by various financial institutions, the frequency of reporting, opinion about the effectiveness of regulation and the response to the possibility of a unified regulator.

The instruments were not pre-tested because of the relatively small size of the target population. However, the structure of the questions was reviewed by University personnel for clarity, ability to initiate discussion, sequencing and whether it adequately covered the area of investigation.

Purposive sampling was employed in conjunction with the snowballing technique to determine the sample. Purposive sampling, also referred to as judgmental sampling, is based on specific characteristics a population meets. The persons targeted in the research were those holding managerial positions at the regulatory agencies and the regulated institutions and were actively involved in the regulatory process. However, we should note that purposive sampling, as a non-probability method, has the limitation of being prone to researcher bias. Nevertheless, the presence of researcher bias is only a serious drawback when

[1] The instruments are available on request.

the researcher's justification for utilizing purposive sampling is ill-conceived or poorly understood (Wood and Brathwaite, 2014). The snowballing technique, also referred to as chain-referral sampling or respondent-driven sampling, is a recruitment method which requires participants with whom contact has already been made to use their social networks to refer the researcher to other potential participants. The snowballing technique allows the most relevant persons to be contacted and provides encouragement for their participation.

The regulated entities were selected based on whether they interacted with both the Financial Services Commission and the Central Bank. Interaction with both regulators was considered to be occurring if the financial institution provided services that were regulated by both regulators, was a member of a financial group where members of the group were regulated by one of the authorities or if there was a recommendation that the entity be regulated by an authority other than the one which currently regulated it. These criteria were used since these entities were considered most suitable to envisage the impact of any change in regulatory structure because of their familiarity with the work of the regulators. The sample of regulated financial institutions includes one bank that was regulated by both regulators, one credit union and finance company group, one large credit union which the recent Financial Sector Assessment Report recommended be moved to the regulation of the Central Bank, and one insurance company and finance company group.

There were a few limitations associated with the data-collection process. First, the sample size of the dual regulated entities was somewhat limited. Representatives of other financial institutions were approached but declined to participate in the study. Second, the analysis was restricted to the domestic component of the financial system; hence, the impact of regulation on the international financial sector was not included. Only the domestic system was reviewed because the international financial sector (while providing benefits to the economy via job creation, fees and tax payments, and benevolent

donations) is not allowed to conduct business with most residents and, therefore, does not impact the local financial intermediation process in a significant way.

5. FINDINGS

The findings are presented in two sections. The first section considers the views of the regulators and the second section focuses on the views of the regulated financial institutions.

5.1 Regulators' Views

Relations between Regulators

The regulators' responses revealed that the CBB and the FSC have a close working relation which was formalized via the signing of a memorandum of understanding between the two entities. This document was designed to allow for information sharing and established clear lines of responsibility for dealing with various matters by each agency. The two regulators communicate on a very frequent basis and have formal meetings at least quarterly. However, leading up to the publication of the Financial Stability Report they meet more frequently. They tend to focus on matters such as regulatory and supervisory issues since there are a number of dual registrants. Trends or concerns from either regulator on financial groups are also discussed. In addition, because the CBB is the more seasoned regulator the FSC draws on the Central Bank for guidance.

On the other hand, the three regulators agreed that the CBB and the FSC have a limited relation with the FTC. The FTC mainly consults the other regulators when conducting studies.

Basis and Principles of Supervision

The CBB applies a risk-based supervisory method, in line with the Core Principles for Effective Banking Supervision issued

by the Basel Committee on Banking Supervision.[2] These principles state the powers a supervisor should have enshrined in law and the minimum prudential requirements that supervisors should impose on licensees. While all banks are monitored, an assessment of the risk in each bank is done and higher-risk banks are reviewed more frequently. The CBB also follows the Financial Action Task Force recommendations on combating money laundering and terrorist financing. These include ensuring that the financial institutions have information systems, personnel and processes in place to monitor customer transactions for suspicious activity and that they are adequately reported.

The FSC also uses a risk-based system of regulation where the greatest level of resources is placed on those entities that pose the greatest level of risk to the stability of the system. The processes of the FSC are guided by international core principles and best practices in all of the sectors which it regulates. For example, the FSC follows the principles of the International Association of Insurance Supervisors (IAIS)[3] for insurance supervision and utilizes the monitoring system PEARLS[4] developed by the World Council of Credit Unions for credit unions under its purview.

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[2] The Basel Committee on Banking Supervision (BCBS) is a committee of banking supervisory authorities which was established by the Central Bank Governors of the Group of Ten in 1975. It is hosted by the Bank for International Settlements and provides a forum for cooperation on banking supervisory matters.

[3] The International Association of Insurance Supervisors (IAIS) is a voluntary membership organization of insurance supervisors and regulators. The mission of the body is to promote effective and globally consistent supervision of the insurance industry.

[4] The PEARLS system allows regulators to evaluate the protection, effective financial structure, asset quality, rates of return and costs, liquidity and signs of growth of licensees using predetermined ratios in each category.

Roles and Responsibilities of the Regulator

The views of the respondent from the CBB can be summarized as follows:

1) The main role of the CBB is to monitor the safety and soundness of the banks and finance companies. In addition, the CBB is represented on the Caribbean Financial Action Task Force (CFATF) and is part of the local Anti-Money Laundering Authority Board. A Bank's representative sits on CFATF working groups on behalf of the Barbados delegation and also offers services as a financial assessor for mutual evaluations.

2) The CBB also has responsibility for macroprudential supervision, as facilitated through the Financial Stability Unit. Currently, the Unit prepares the Financial Stability Report and conducts stress tests on individual banks as well as system wide. Eventually, the Unit will have responsibility for policy matters, for example, if credit is growing too quickly in the sector what may be needed to slow the pace of growth. The Unit benefits from an information-sharing arrangement with the Bank Supervision Department and vice versa.

3) The CBB does not have code-of-conduct responsibility. Any responses to queries are voluntary, but responsibility may be in the remit of the FTC. However, the FTC "appears to focus more on competition." In the past the CBB has issued guidance notes to the industry on some fees; however, there are drawbacks in that regulating fees may take away from competition. In addition, there may be a conflict of interest since the regulator, when reviewing a licensee's capital position, may have concerns about the licensee's ability to generate revenue and, therefore, grow the capital base; but the same regulator may have restricted the growth in the capital base by limiting the level of fees that licensees can charge. The representative suggested that

there may be a need for an Office of Financial Ombudsman, as there is in Trinidad which is staffed by officials from the Central Bank of Trinidad and Tobago.

4) The CBB does not have competition authority. However, at licensing the agency ensures that the new entity would not be breaching the legal limit of 40% of market share of total assets. After this stage the FTC has sole authority for competition. The view was expressed that there is a need for the FTC to consult the CBB before making a decision on a merger or acquisition, since from a prudential perspective there are times when having a larger company acquire another, even if it breaches the 40% of market share rule, may actually help the market concerns and be in the interest of financial stability. This is especially true in cases where a bank is in distress and is unable to meet its obligations. If such an institution is taken over by a large, well established bank this reduces panic in the market and in a sense restores confidence to the banking system.

The views of the respondent from the FSC can summarized as follows:

1) Facilitation of macroprudential regulation was not organized across all of the sectors at present. There are, however, elements of macroprudential regulation included in the analysis of the sectors. The FSC is currently formalizing a program through which there can be a more structured approach to this type of regulation. The FSC is also implementing a risk-based supervisory framework which incorporates the use of stress tests, especially in relation to the insurance and credit union sectors. Further, the FSC participates in the Financial Stability Report preparation with the CBB.

2) The FSC has in its mandate to properly ensure that customers are treated fairly and that "it takes market conduct abuses seriously." In addition, the FSC is indirectly responsible for maintaining an appropriate level of competition.

Hence, it is concerned with prudential, market conduct and competition regulation.

3) With regard to Anti-Money Laundering (AML) regulation the FSC collaborates with the Financial Intelligence Unit and has a seat on the Board of the Anti-Money Laundering Authority.

The views of the respondent from the FTC can be summarized as follows:

1) The FTC's role is to safeguard the interest of consumers, promote and encourage fair competition and ensure efficient regulated utility services.

2) In relation to the financial sector, the FTC receives consumer complaints about banks and these are dealt with via the Consumer Protection Act. When a complaint comes, it is investigated to determine if the financial institution has misled or acted outside of the arrangement agreed with the customer. It was noted that the Consumer Protection Act is a criminal act with an aim of changing behavior. Once the FTC intervenes the issue is resolved but the circumstances surrounding the issue, if any, must also be addressed to prevent it from affecting other customers.

The FTC also investigates financial institutions in an effort to determine if there is collusion.

Opinions on the Adequacy of Regulation

All of the regulators expressed the view that the financial sector was well regulated, though there are some areas where regulation can be improved. The FSC representative noted that "at this point in time with a 'dual-regulator' regime there are sufficient tools to ensure adequate regulation." The regulators, however, cautioned that regulation will not prevent institutional failure or crisis. The banking regulator stated "regulation will not prevent crisis as there are constantly new products

emerging and it is difficult to capture everything. But they (the licensees) cannot be left to do their own thing as they have people's funds, so they must be regulated." Further, none of regulators felt that the sector was over-regulated. They responded that given the importance of the sector, it needs to be subjected to strong and effective regulation which allows business to function but safeguards policyholders, depositors and investors. The CBB representative went further saying, "I think the right balance has been struck in Barbados, it is not as tough/heavy-handed as the case in other jurisdictions or as the Financial Sector Assessment Program assessors may have wanted. That is, we do not impose punitive penalties; we try to work with licensees to comply. The United States of America, for example, has a more punitive, heavy-handed approach." The FSC representative believed that the sector was not over-regulated since "the two key signals of over regulation are the increasing cost of and availability of capital. Thus far, in Barbados there is still the positive availability of capital and the cost of capital is reducing."

Opinions on the Consolidation of the Prudential Regulators

Respondents from the prudential regulatory agencies acknowledged that there would be advantages and disadvantages to having one regulator for all types of financial institutions. The identified advantages are as follows. First, there would be better coverage of financial groups since the use of one regulator would lessen the challenges associated with information sharing even with a MOU in place. These challenges relate to the timeliness and completeness of the information. Second, in a crisis the single regulator may be better able to manage the knock-on effects, thereby achieving a greater containment of risk. Third, as noted by one respondent "in a properly functioning entity, the removal of bureaucratic blocks and having to deal with different sets of organizational and regulatory cultures can be very effective." Finally, the volume of work handled by a consolidated regulator would allow for adequate utilization of an enforcement team.

A major disadvantage identified with having a single prudential regulator is the potential loss of focus since the consolidated regulator's operations may be too unwieldy to properly manage. This could also lead to the development of silos and information not being properly disseminated. One respondent suggested that the consolidated supervisor be organized so that *common risk* across the entire financial sector can be reviewed by specialist teams. For example, consider that credit risk can be found in banks, credit unions or insurance activity. This means staff would need to be very flexible, knowing the standards for insurance companies, banks and credit unions.

An area of concern for the bank regulator was whether the consolidated supervisor would be within the central bank structure or a separate body. He opined that if the consolidated regulator was not incorporated into the CBB this would be a major disadvantage to the CBB, as the situation would create a potential disconnect between the CBB as the lender of last resort and the banks. The CBB would therefore lose the intimate knowledge of the banks which was ascertained via the regulatory oversight of them. On the other hand, if the CBB was the regulator, one of the advantages would be that its lender of last resort function could be extended to non-banks, if required.

5.2 Financial Institutions' Views

Types of Reports Submitted to the Regulators

The respondents from the financial institutions indicated that they are required to submit financial information such as balance sheets and income statements on a monthly and quarterly basis to both prudential regulators (CBB and FSC). They also reported that they are required to submit qualitative information such as changes in management, policies and manuals, and minutes of the meetings of the board of directors and senior management committees on request.

Differences in Products

The interviewees noted that there was no significant difference between their products and those of other institutions. They stated that credit unions, finance companies and banks basically offered similar services. The representative from the banking group noted that their ability to offer chequing services, facilitate payroll and provide letters of credit and guarantees differentiated them from credit unions, insurance companies and finance companies. One finance company respondent also noted that insurance companies were now also competing in the mortgage market and offering loans against policies. On the other hand, the insurance company respondent did not find its services similar to the other types of financial institutions since its focus was on providing various types of insurance such as life, health, creditor life, and mutual funds and pension plans with its mortgage lending business not being considered core to the company.

Differences between the Financial Services Commission and Central Bank Requirements

The representatives from the financial institutions did not identify any differences between the Central Bank requirements and those of the Financial Services Commission. One respondent noted that "the FSC guidelines and regulations tend to mirror the CBB." It was also noted that the requirements for credit unions relating to non-performing loans are now very similar to those for banks. While there were no differences, one of the respondents indicated that it often meant seeking approval from one regulator before it could carry out the instructions of another. She explained that "for example, currently the FSC requires the use of the name brokerage in the list of entities involved in that type of business. To facilitate, we want to set up a separate brokerage subsidiary since that is not part of our core business; however, we have to get written approval from the CBB to proceed. If the CBB's response is delayed, we may miss the FSC's correction timeline."

Opinions on the Effectiveness of the Sector's Regulation

The interviewees considered the current regulatory regime effective. They stated that since the financial crisis, the regulatory oversight and guidance by the Financial Services Commission has increased. This is evidenced by the issuance of guidelines and regulations. However, two of the respondents cautioned that the FSC is still a very young organization and has not faced any significant tests in terms of enforcement of the regulations. One of the interviewees expressed concern that her organization, given its size and contribution to the sector's assets, had not yet been inspected by the FSC. To directly quote the respondent she felt "on paper there was effective regulation, but more experienced regulators of credit unions from jurisdictions like Canada are needed to assist in the FSC's development." Another respondent, while acknowledging the effectiveness of the regulation, noted that the cost of regulation, particularly anti-money laundering legislation, is high.

Also, none of the interviewees felt that the sector is overregulated. One representative remarked there was a balance between the regulators' control and their ability to conduct business. Another interviewee felt that the sector is not overly regulated since "to a large extent, the market is allowed to dictate fees, interest rates and introduce new services as well as increase overall lending and lending to specific sectors without restrictions being imposed by the regulators, unlike in other jurisdiction which have restrictions enshrined in legislation."

Impact of a Consolidated Supervisor

None of the respondents believed that a move to a consolidated regulator would impact on their organization's structure. Those respondents representing organizations that are part of a financial conglomerate felt that each of the institutions in the group still had different purposes to allow them to remain separate. It was noted, however, that if the consolidated

entity represented a merger between the CBB and the FSC "this should provide synergies and give the non-banking sector the benefit of the Central Bank's long standing regulatory experience." Hence, the respondents also suggested that the consolidated regulator should be part of the CBB rather than a separate body. They did not believe that the prudential role would conflict with the CBB's monetary policy role.

Another interviewee outlined the benefits to the organization of having a consolidated regulator such as less reporting requirements, a standard train of thought across the organization and a standard set of enforcement.

Preference of Regulator

All respondents considered the CBB the stronger regulator. This view was based on its length of time in operation; therefore, it is more experienced and has greater presence via the frequency of inspections and influence on the financial sector. The respondents noted, however, that with time the FSC should develop into an equally strong regulator as the Central Bank.

6. DISCUSSION OF FINDINGS

Barbados' regulatory regime, like most other countries, does not fit neatly into one of the types of regulatory structures previously discussed. The FSC is an integrated regulator with oversight of all non-banking institutions. It also carries some elements of a super/mega regulator since it has code-of-conduct and competition authority. However, because there are other regulators with responsibility for code-of-conduct and prudential regulation it cannot be considered a mega regulator. The system also bears some elements of the institutional regulatory approach in which the type of regulation is based on the legal status of the entity. The remainder of this section presents an analysis of the findings.

Benefits to the Financial System of Having One Prudential Regulator

The findings revealed that there are possible benefits to having one prudential regulator. First, one consolidated supervisor would allow for better oversight of financial groups and could lead to better enforcement through the development of a specialized enforcement team. Also, one prudential regulator would allow for better monitoring of key risks throughout the sector. These views of the respondents are congruent with the widely-held views in the literature that one prudential supervisor can provide economies of scale and scope, and lead to more effective regulation (Reddy, 2001; Podpiera and Čihák, 2006; Pellerin et al., 2009). Second, from the financial institutions' perspective, one consolidated regulator should reduce the number of duplicated returns currently submitted to the two regulators. It should also remove the need to seek approval from one regulator in order to fulfil the requirements of another.

The regulators, however, cautioned that a combined entity could pose one main disadvantage: The loss of focus of the entity as the operation becomes too large to be properly managed. This view is also consistent with the literature which notes that one of the drawbacks of the consolidated regulator is the lack of focus which may undermine its efficiency and effectiveness (Reddy, 2001; Llewellyn, 2004).

From the responses it was observed that the two prudential regulators are involved in macroprudential supervision. This represents a duplication of effort. The literature suggests that where regulators are performing the same task it may indicate a need to combine the regulators.

The Role of the Central Bank of Barbados

Currently the CBB operates as the regulator for banks in addition to its responsibility for monetary policy. Both categories of respondents are supportive of this dual role for the CBB instead of moving bank supervision within the FSC. Their rationale for

this preference is that the experience and stature of the CBB is beneficial to the oversight of the sector and they do not find the monetary policy role in conflict with the regulatory role. This position finds some support in the literature where it is noted that prudential regulation in some developing countries may benefit from the perceived independence and prestige associated with the central bank (Schooner and Taylor, 2010). Further, the CBB's dual responsibility for monetary policy and prudential regulation is similar to the structure that exists in more than 60% of jurisdictions covered in the World Bank's Bank Regulation and Supervision Survey 2012. In this regard the CBB is following a well-established practice.

Similarly, the CBB's respondent prefers the CBB to maintain responsibility for at least banks and finance companies since the CBB has the lender of last resort responsibility to banks. The literature provides some support for this view, noting that the lender of last resort needs to be adequately knowledgeable about the financial viability of the institutions which it may be called upon to assist. Further, the literature suggests that the separation of the prudential regulator and the lender of last resort function in England may have contributed to the collapse of Northern Rock (Taylor, 2013).

Conflicts between Regulators

It was observed from the respondents that currently the mandates of the CBB and the FSC are complementary and their relation is guided by a memorandum of understanding which reduces the likelihood of conflict between the two regulators. However, no memorandum of understanding exists between the two prudential regulators and the FTC. Hence, there is a likelihood of conflict in some situations between the FTC and the CBB, and between the FTC and the FSC.

The situation is more acute in the instance of the FTC and FSC since both entities have in their mandate code-of-conduct and competition authority. Both regulators also indicated that they have limited contact with each other. As a result the

environment exists for the financial institutions under their dual auspices to receive conflicting instructions from the two regulators. Further, in the absence of a MOU between them it cannot be easily determined which regulator may have priority in a particular situation.

A similar situation exists between the CBB and the FTC. The main difference is that the CBB does not have either code-of-conduct or competition authority. However, it still handles customers' queries and issues guidance on fee structures to the industry. While this may have been necessary before the formation of the FTC, it creates an environment for conflicting guidelines. Further, in the area of licensing the CBB and the FTC may conflict on whether a financial institution should merge with another since the impact on competition in the sector may be irrelevant to the CBB when compared with the financial health and stability of an institution.

To deal with the instances of conflict the two prudential regulators should establish a MOU with the FTC outlining their roles and responsibilities (with respect to each other) in various situations. It is also recommended that the FSC relinquishes responsibility for code-of-conduct and competition authority to eliminate the conflict as suggested by the financial stability assessors (International Monetary Fund, 2014). Further, the informal role of the Central Bank as code-of-conduct regulator should also be relinquished. The public would then have to be properly sensitized that code-of-conduct and competition issues would have to be directed to the FTC. We should note, however, that appropriate arrangements would have to be made for the operationalization of the proposed MOU to ensure maximum effectiveness.

7. CONCLUSION

It is well established that the financial system plays a vital role in the growth of economic activity. It is therefore incumbent on governments to have strong and effective regulatory structures in place to ensure safe and efficiently functioning

financial systems. Hence, periodic review of the effectiveness of the financial regulatory framework is necessary. This paper therefore examined the adequacy of the financial regulatory framework in Barbados.

Some important findings emerged from the analysis. First, while there may be benefits from having one prudential regulator, it is not necessary since the respondents are satisfied with the current system and the change would not have a significant impact on the products and services offered by financial groups or the efficiency and effectiveness of prudential regulation. Hence, the current dual prudential regulatory framework (with the CBB and FSC) can be considered adequate for Barbados. Nonetheless, if in the future the decision is made to have a consolidated prudential regulator it should be part of the Central Bank.

Second, there are instances of conflict between the two prudential regulators and the Fair Trading Commission. Thus, a MOU should be created between the prudential regulators and the FTC to ensure that the lines of responsibility for certain aspects of regulation by the three agencies are better delineated.

Third, respondents did not perceive any conflicts with the Central Bank's responsibility for prudential regulation and monetary policy. This view is based on the CBB's history in regulation and its status in society. The dual regulatory role played by the CBB is a structure that is well-established in many other countries.

Though the study provides an interesting review of the Barbadian financial regulatory framework, it can be extended to include the international financial services industry and the impact of regional regulation since many of the financial institutions operate throughout the region.

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Financial Education and Inclusion in Latin American and Caribbean

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Financial education and inclusion have captured the interest of different international players, as well as global and regional forums. Governments in the region and around the world have also identified financial education and inclusion policies as a tool for promoting economic growth and social equality within a context of financial stability. Central banks and superintendencies are among the most important institutions leading financial education and inclusion programs. In order to better understand the role of Latin American and Caribbean central banks and superintendencies in financial education and inclusion programs we invited such institutions to answer two surveys. Twenty three central banks and 17 regulatory bodies or superintendencies from the region took part in the study. The surveys helped to identify the role of these institutions in financial education and inclusion programs.

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