Marriage, Markets and Money: A Coasian Theory of Household Formation*

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February 24, 2012

Abstract

This paper develops a general equilibrium theory of household formation – i.e., *marriage* – following Coase's theory of firm formation. Individuals in the model consume both market- and home-produced commodities, and home production is facilitated through marriage. Market frictions, including taxation, search and bargaining problems, increase marriage rates when home and market goods are substitutes. In particular, inflation, as a tax on market activity, makes household production and hence marriage more attractive, as long as singles use cash more than married individuals, which is supported by data. The prediction that inflation and other taxes affect household formation is also supported by evidence.

Keywords: Marriage, Markets, Money, Households

JEL Classification Numbers: J12, H31, E52, D13

*We are indebted to many people for comments and conversations, including Michelle Tertilt, Bob Hall, Lones Smith, Neil Wallace, Scott Schuh, and especially Francesco Lippi, who was very generous in sharing his data and helping us understand it better. We also thank seminar or conference participants at Penn, Princeton, Wisconsin, Aarhus, Toronto and the SED meetings in Ghent. Wright thanks the NSF and the Ray Zemon Chair in Liquid Assets at the Wisconsin School of Business for research support. As usual, the views expressed here are those of the authors, and no responsibility should be attributed to the Bank of Canada, the Federal Reserve System, or any Federal Reserve Bank.

For centuries marriages, births, and other family behavior have been known to respond to fluctuations in aggregate output and prices. Gary Becker (1988).

1 Introduction

This paper is about marriage – i.e., household formation. In order to understand the institution of a household, it helps to contemplate how economists think about other institutions, such as firms. In a classic paper, Coase (1937) asks why the economy has some activity organized within business firms, as opposed to independent self-employed individuals, who contract with one another as needs arise. Production could in principle be carried on without organizations like firms, with all activity orchestrated by the market. Why do firms emerge? Coase says this happens when an entrepreneur begins to hire people, forming a team under the entrepreneur's direction, and considers conditions where this dominates contracting out individual tasks.

If markets are efficient, it should not be preferable to hire people into a firm rather than contracting for individual goods and services as needed. Coase argues, however, that there are a number of transactions costs involved in using the market, including information costs of the type that search theorists analyze, as well as bargaining costs:

> The main reason why it is profitable to establish a firm would seem to be that there is a cost of using the price mechanism. The most obvious cost of 'organizing' production through the price mechanism is that of discovering what the relevant prices are. This cost may be reduced but it will not be eliminated by the emergence of specialists who will sell this information. The costs of negotiating and concluding a separate contract for each exchange transaction which takes place on a market must also be taken into account.

In addition, he emphasizes the effects of various policies:

> Another factor that should be noted is that exchange transactions on a market and the same transactions organized within a firm are often treated differently by Governments or other bodies with regulatory powers. If we consider the operation of a sales tax, it is clear that it is a tax on market transactions and not on the same transactions organised within the firm.

> Now since these are alternative methods of 'organisation' – by the price mechanism or by the entrepreneur – such a regulation would bring into existence firms which otherwise would have no raison d'etre. ... Similarly, quota schemes, and methods of price control which imply that there is rationing, and which do not apply to firms producing such services for themselves, by allowing advantages to those who organize within the firm and not through the market, necessarily encourage the growth of firms.

Firms thus arise to help avoid costs and inconveniences associated with markets. There are limits to what can be produced internally, perhaps, due to decreasing returns, so markets still have a role. But firms' very existence testifies to the fact that markets are not frictionless, and to the idea that organizing certain activities within such institutions can help to ameliorate search, bargaining, taxation and other costs. To give some concrete examples, an entrepreneur may sometimes need legal, accounting, secretarial or other services, all of which are available on the market. One can always try to find independent contractors to perform these duties – but this involves transactions costs. When these costs are sufficiently high, it becomes worthwhile to bring some of the activity *in house*, by which we mean setting up one's own legal team, accounting department or secretarial pool. As more and more activity is performed in house, we have the genesis of the organization known as a firm.[1]

We think this approach can help us understand the emergence of other organizations, as Coase (1992) himself suggests. Here we study households, or families. A narrow reading of Coase might suggest the theory does not apply to families, because he said it was important for a firm to have an "employee and employer" relationship resembling a "slave and master" relationship: workers are not independent contrac-

[1] Coase was aware of alternative candidates for a theory of the firm, including specialization, risk allocation, and the notion that entrepreneurs have better knowledge or judgement, but dismissed them because in principle these can all be handled by the market: "What has to be explained is why one integrating force (the entrepreneur) should be substituted for another integrating force (the price mechanism)." Following Coase, Alchian and Demsetz (1972) argued that firms emerge because team production is more efficient than individuals working at arm's length, through the market, but success depends on managing opportunistic behavior. Monitoring is necessary, and is more effective if the monitor is residual claimant (see also Williamson 1981 and references therein). We do not incorporate intrafamily monitoring explicitly in this paper, although one could.

tors paid to deliver specified products, but are subject to direction and control by the firm. Of course, this could be said of some families, and it does not apply to all firms, e.g., cooperatives or partnerships. We think households can be profitably analyzed using Coasian logic, even if their internal operations better resemble happy families or partnerships than "slave-master" relationships. As with legal, accounting or secretarial services for firms, many goods and services for individuals can be provided by the market or the household, including cooking, cleaning and child care. Even companionship and sex can be obtained at home or on the market. When the costs of using markets are high, individuals, like firms, are more inclined to bring activity in house, especially when market and home commodities are good substitutes, and when home production is enhanced by forming a household that operates more or less as a team.

We are not proposing that a transitory blip in sales taxes on any given day will trigger a stampede to the altar, but if individuals find themselves in a long-term situation where the cost of using the market is higher, they will be more inclined to set up households and engage to a greater extent in home rather than market activity. Of course, love may have something to do with it, too, but it is by no means a radical idea to suggest that economic considerations impinge on marriage and other family behavior, as Becker emphasizes in the epigraph, and as is well recognized by popular media.[2] Especially when one considers frictions, in the sense that it takes time and other resources to find an acceptable, let alone ideal, partner, it is not trivial to get married and start a family. Rational individuals do not search forever, but use reservation strategies, stopping when they find someone with whom the benefits of partnership formation outweigh the benefits of continued search.

[2]Based on census data, *USA Today* (5/5//11, p. 3) concludes "Just as growing affluence let many Americans live with fewer people, the recession, high unemployment and the housing bust now are forcing some people to double up." The next day they ran a similar story on having children. Family considerations clearly are affected by business cycles, and probably still more affected by longer-term changes – e.g., secular declines in marriage rates may be related to transactions costs decreasing with the advance of technology (as they say, it is easier to shop online than in line).

To study how transaction costs affect reservation strategies we develop a formal search-based model of marriage, by which we mean household formation, since we do not have a lot to say here about whether this involves certification by a church, city hall or captain at sea, on the one hand, or what they used to call living in sin, on the other. We use a general equilibrium framework, by which we mean individuals engage in more than simply looking for partners, as in most previous economic analyses of marriage (see below for references). In addition to searching for and eventually settling down at least temporarily with partners, individuals here also participate in markets where consumption goods, labor and assets are traded. It is important to have retail goods markets to capture the idea that some demands may be satisfied either by the market or the household. It is also useful to have asset markets, for reasons that will become clear, and to have labor markets, since this actually simplifies the analysis on multiple dimensions. Some of our goods markets have explicit frictions, including taxation, search and bargaining. One extension also has frictions in the payment system, which makes money essential, and allows us to study the effect of inflation as a tax on market activity.

The monetary version of model is interesting for the following reason. First, we would argue that being single is cash intensive, since goods and services like meals, cleaning etc. that can be provided by the home or market are more likely purchased on the market by singles. These items are not always purchased using currency, of course, but they are certainly purchased this way more often than their home-produced substitutes, since, by definition, household production is not even traded, let alone traded using cash (with exceptions, like paying children to do their chores). Moreover, dating – going to bars, taking taxis, leaving tips etc. – is clearly more cash intensive than hanging around the house – watching TV, having family dinners, etc. – and it seems reasonable to think that singles engage more in dating-like activity. All off this suggests that being single is on the whole cash intensive (also with exceptions, like paying the nanny). We show this is supported by micro data. Given this, theory predicts that inflation leads to more marriage. Given that, we can go to the macro data using not only information on sales and income taxes, but also inflation, on which we have many more countries and longer time series. We examine marriage rates in a panel of countries to see how they correlate with inflation, as well as other taxes, and factors like unemployment and output.

In terms of the literature, we are not the first to notice a similarity between households and firms. Long ago, Becker (1973) proposed "marriage can be considered a two-person firm with either member being the 'entrepreneur' who 'hires' the other," and search theorists often use their equations almost interchangeably to discuss marriage or employment, as discussed in the survey by Burdett and Coles (1999). But it is novel to rigorously apply Coasian logic to marriage in a dynamic general equilibrium model with explicit frictions. Of course some of the ideas can be found elsewhere. Pollack (1985) surveys what he calls the transactions cost approach to family behavior.[3] Again, the difference is that we use dynamic general equilibrium theory with explicit frictions. Our approach is also related to much work on home production; see surveys by Greenwood et al. (1995) and Gronau (1997) (for a more up-to-date list of citations, see Aruoba et al. 2011). See the Rupert (2008) volume, the paper by Siow (2008), and references therein, for other relevant work.

The paper is organized as follows. Section 2 describes the environment. Section 3 presents baseline results on how marriage is affected by frictions – i.e., search,

[3] Relatedly, in gender studies Jacobsen (2007, 64-66) also emphasizes transactions costs can be reduced through living with others: "many household production activities are time-consuming to contract for separately. In order to duplicate the activities of one household member performing nonmarket activities, it may be necessary to hire a maid, cook, butler, plumber, and others. There are often substantial monetary costs involved as well, such as the plumber who charges a fixed amount per service call as well as an hourly rate. Search costs are included in this category." She also understands the point of Coase we mentioned in fn. 1, when she says "The ability to specialize and thereby increase per capita output available to household members is the factor most cited by economists in considering the economic rationale for household formation ... However, it is not obvious... that it is necessary for persons to live together in order to reap the benefits from specialization and trade. This model is also applied to trade between countries, but does not imply that countries should also merge their legal and social systems and operate as one nation."

bargaining and taxation. Section 4 discusses extensions. Section 5 presents the empirical analysis, using both micro data on cash usage, and macro data relating marriage to a list of aggregate variables. Section 6 concludes.

2 Environment

Time is discrete and continues forever. There are two types of individuals, men and women, each with measure 1/2, so the total population has measure 1. Except for their labels, men and woman are treated symmetrically. They all discount across periods at rate $\beta \in (0,1)$. There are two types of firms, producers and retailers, owned by individuals. The measure of production firms is irrelevant, due to constant returns, while the measure of retail firms is n. In each period, agents interact in three distinct markets: (1) a frictionless market, in the spirit of Arrow-Debreu, where they trade assets, labor and some goods; (2) a market where they trade other goods, incorporating frictions, in the spirit of Kiyotaki-Wright; and (3) a market where single individuals search for marriage partners, in the spirit of Burdett-Coles. To help keep track of the different markets, we refer to them as AD, KW and BC.[4]

Denote the value function of an individual in each of the markets by V_1, V_2 and V_3, with subscripts describing in the order in which they convene. In AD, we assume for ease of exposition that a good x can be produced one-for-one using labor ℓ (it is an easy extension to go beyond one good and a linear technology). Good x, which we choose as numeraire, can be purchased from producers by individuals for consumption, or by retail firms for conversion into a different good y to be sold in the KW market. Generally, if retailers make an investment in AD of k units of x, and sell $y \leq k$ units in KW, they can convert unsold inventories $k - y$ into $\rho(k - y)$ units of x in the next

[4] Although we label our frictional goods and marriage markets KW and BC, we do not mean to negelect other contributions, any more than we mean to slight other work in GE theory by calling our frictionless market AD. Work on frictional goods markets is surveyed by Williamson-Wright (2010) and Nosal-Rocheteau (2011). For marriage markets, see Becker (1991) and references therein, and more recently Mortensen (1988), Burdett-Coles (1997), Burdett-Wright (1998), Eeckhout (1999), Shimer-Smith (2000), Burdett et al. (2004), Atakan (2006) and Smith (2007).

AD market. Hence, the opportunity cost of selling y in KW is

$$c(y,k) = \rho(k) - \rho(k-y) \,. \tag{1}$$

Single individuals participate in the BC market, where λ is the probability of meeting a potential partner, each period (it is a trivial extension to have singles access BC with probability less than 1 each period). If they meet no one, they continue directly to the next AD market. But if a man and woman meet, they mutually decide whether to enter into a partnership that we call marriage. Marriages break up at at rate δ, which is exogenous for now. What makes this market interesting is that not all partnerships are created equal: when a man and woman meet, generally, they draw a payoff pair (z, z') describing the flow utilities each would receive if they were to enter into a relationship. Here we focus the scenario where $z = z'$ with probability 1, which means they agree on how much they get from each other, so that we can ignore bargaining in this part of the model. Draws of z across meetings and time are i.i.d. and the CDF is $F(z)$. In equilibrium, individuals chose a reservation value R, such that they are willing to enter into marriage when $z \geq R$.

Here z can reflect home production, including not only the drudgery (or the joy) of cooking, cleaning etc., but also the joy of sex and companionship (or the drudgery, as the case may be). The idea is that individuals may be able to engage in some home production on their own, but can potentially do more, or do better, in a partnership with a high z. This captures the notion that household production is facilitated by household formation. It stands in for a more detailed description of household activities, which generally involve decisions about the allocation of time and capital, as discussed in the work mentioned in the Introduction. Following that approach, one might write for a married couple

$$z = \max_{\ell_h, \ell'_h, k_h} \left\{ \chi\left(\ell_h, \ell'_h, k_h, \xi\right) - \ell_h - \ell'_h \right\}, \tag{2}$$

where ℓ_h and ℓ'_h are the spouses' hours of home work, k_h is their joint home capital, including the house, appliances etc., and $\chi(\cdot)$ is a home production function with ξ a component specific to the partnership. In this specification, randomness in ξ across matches generates randomness in z.

Rather than going into post-marriage decisions concerning home work and other inputs, in order to focus on the prior decision to get married, in the first place, we take z as an exogenous random variable. Obviously, whether or not this is innocuous depends on the application, and one can go into more detail. But the essential ingredient for our purposes is simply that people differ in how much they are attracted to each other, how well they work together, etc., as captured by z. In Burdett and Coles (1997), z is called *pizzazz*, which might be related to *love*, and we will have more to say about that below. For now, z remains the same across periods, except that at rate δ the relationship breaks up for good. In terms of notation, any individual has martial status indexed by $z \in [\underline{z}, \overline{z}] \cup \{s\}$, where $z = s$ means they are single, and otherwise z gives the quality of their relationship.

In sum, there are four types of commodities: labor ℓ and good x are traded in AD; a different good y is traded in KW; and there is a nontraded home-produced BC good z. Within-period utility is $\mathcal{U} = \mathcal{U}(x, y, z) - \ell$, which is linear in ℓ, to simplify the analysis. To focus attention on interaction between home production and commodities acquired in frictional markets, y and z, we let $\mathcal{U}(x, y, z) = U(x) + u(y, z)$.[5] Whether y and z are substitutes or complements depends on whether $u_{yz} < 0$ or $u_{yz} > 0$. To determine whether marriage *per se* is a substitute for markets, however, one cannot just take a derivative, since matrimony involves a discrete change in state from $z = s$ to $z \in [\underline{z}, \overline{z}]$. As benchmark, we assume

$$u(y, s) = \varepsilon_0 v(y) \text{ and } u(y, z) = \varepsilon_1 v(y) + z \ \forall z \neq s, \tag{3}$$

where v satisfies the standard assumptions plus $v(0) = 0$, and we relegate more general results to Appendix A. In (3) marriage affects one's payoff in two ways: it changes

[5] We could eliminate x entirely; as it does not complicate the analysis, we include it to show not all consumption need be acquired in frictional markets. One could also eliminate y, use $u(x, z)$, and impose a tax on x, but this would not allow one to discuss search, bargaining and payment frictions.

the marginal utility of y when $\varepsilon_0 \neq \varepsilon_1$; and it gives a flow utility z, over and above what one gets while single, which is normalized to 0, but we allow $z < 0$ so that being with some people is worse than being alone. The key feature is that, when $\varepsilon_0 > \varepsilon_1$, getting married reduces the marginal utility of y, meaning that market commodities and marriage *per se* are substitutes.

3 Benchmark

We begin with the case where the retail market has bilateral trade, involving search and bargaining, but no credit frictions. The plan is to describe activities in the AD, KW and BC markets, then define equilibrium, then characterize its properties.

3.1 Equilibrium

For individuals in the AD market, the state variables are marital status z and debt d brought in from the previous period. The value function satisfies

$$V_1(d, z) = \max_{x,\ell} \{U(x) - \ell + V_2(0, z)\} \text{ st } x = w\ell(1 - \eta) - d + \Delta,$$

where $w = 1$ is the real wage, given a linear technology, η is a labor income tax rate, and Δ is other net income from transfers, dividends etc. Notice that individuals pay off all debt in the AD market, which is without loss of generality when $\mathcal{U}$ is linear in ℓ. Hence, we do not have to track any distribution across agents as a state variable, which is one simplification that comes from having labor in the model (as in Lagos and Wright 2005). Using the budget equation, we reduce the problem to

$$V_1(d, z) = \max_x \left\{ U(x) - \frac{x + d - \Delta}{1 - \eta} + V_2(0, z) \right\}. \tag{4}$$

Hence, x is determined by the FOC $U'(x) = 1/(1 - \eta)$. Also, $\partial V_1/\partial d = -1/(1 - \eta)$, independent of (d, z).[6]

[6] Without changing any substantive results, we can make this look more like standard GE theory by replacing x in utility with $\mathbf{x} \in \mathbb{R}^n$ and replacing it in the budget equation with $\mathbf{px}$ where $\mathbf{p} \in \mathbb{R}^n$.

Production firms in the AD market are trivial, since with a linear technology they are willing to demand any amount of labor and supply any amount of output at $w = 1$. Retail firms solve the slightly less trivial problem

$$\max_k \left\{ -k + \frac{1}{1+r}\Pi(k) \right\},$$

where k is an investment of AD goods in inventories, while $\Pi(k)$ is revenue accruing in the KW market, derived below, discounted because it is only paid over to shareholders in the next AD market. The appropriate discount factor with quasi-linear preferences is always $1 + r = 1/\beta$, and therefore the FOC is $\beta\Pi'(k) = 1$.

In the KW market, trade is bilateral, and involves individuals getting y from retailers in exchange for a debt commitment d. Let $A\alpha_0$ be the arrival rate of a spending opportunity for a single and $A\alpha_1$ the arrival rate for a married individual. Thus A measures the general matching efficiency in the KW market, while α_0 and α_1 are specific to marital status. We usually assume $\alpha_0 \geq \alpha_1$, with a simple special case being the one where married individuals do not participate in KW at all, $\alpha_1 = 0$. If $\alpha_0 > \alpha_1$ then marriage and markets substitutes in terms of opportunities, just like $\varepsilon_0 > \varepsilon_1$ means they are substitutes in preferences. In any case, we have

$$V_2(0, z) = z + A\alpha_1 \left[\varepsilon_1 v(y_z) + V_3(d_z, z)\right] + (1 - A\alpha_1)V_3(0, z), \tag{5}$$

where (y_z, d_z) denotes terms of trade between a retailer and an individual with marital status z, and it is understood that for singles the first term on the RHS vanishes.

For retail firms in the KW market, first, let σ denote the fraction of single individuals. Then the probability a retailer meets a single individual is $\sigma A\alpha_0/n$ and the probability a retailer meets a married individual is $(1 - \sigma)\, A\alpha_1/n$. To see this, for the first probability, note that the total number of meetings between retailers and singles is $\sigma A\alpha_0$, then divide by the number of retailers; similarly for the second probability. This assumes all retailers participate in the KW market, which is true as long as $\Pi(k) \geq 0$ (we check this below; otherwise, only a fraction participate, and arrival rates adjust to satisfy zero profit, exactly as in Pissarides 2000). Retail profit is[7]

$$\Pi(k) = \rho(k) + \frac{\sigma A\alpha_0}{n}\left[(1-\tau)d_s - c(y_s,k)\right] + \frac{(1-\sigma)\,A\alpha_1}{n}\int_R \frac{(1-\tau)d_z - c(y_z,k)}{1-F(R)}dF(z),$$

where τ is a sales tax rate levied on KW consumption y but not AD consumption x (merely to reduce notation).

Moving to the BC market, for single individuals, the value function satisfies

$$V_3(d,s) = \lambda\int_R \beta V_1(d,z)dF(z) + \left[1-\lambda+\lambda F(R)\right]\beta V_1(d,s). \tag{6}$$

In words, with probability λ, one meets another single, and when $z \geq R$ one enters the next period married, while with probability $1-\lambda+\lambda F(R)$ one either meets no one or meets someone with $z < R$ and remains single. For married individuals,

$$V_3(d,z) = \delta\beta V_1(d,s) + (1-\delta)\beta V_1(d,z). \tag{7}$$

With probability δ the match breaks up and one enters next period single, while with probability $1-\delta$ one remains in happy matrimony. Notice $\partial V_3/\partial d = \beta\partial V_1/\partial d = -\beta/(1-\eta)$, independent of z.

This completes the description of payoffs in the different markets. We now discuss the terms of trade in KW. In general, a generic trading mechanism maps a meeting into a pair (y,d). While there are many approaches one could take, for now we use the generalized Nash bargaining solution. To implement this, first note that for an individual with marital status z the trading surplus is

$$S(z) = \varepsilon_z v(y) + V_3(d,z) - V_3(0,z) = \varepsilon_z v(y) - \frac{\beta d}{1-\eta},$$

[7] To derive this, start with

$$\begin{aligned}\Pi(k) &= \left[1-\frac{\sigma A\alpha_0}{n}-\frac{(1-\sigma)A\alpha_1}{n}\right]\rho(k) + \frac{\sigma A\alpha_0}{n}\left[d_s(1-\tau)+\rho(k-y_s)\right] \\ &\quad + \frac{(1-\sigma)A\alpha_1}{n}\int_R \left[d_z(1-\tau)+\rho(y_z-k)\right]\frac{dF(z)}{1-F(R)}.\end{aligned}$$

The first term is revenue in AD for retailers who do not trade in KW; the second is revenue for those who trade with single individuals; and the last is revenue for those who traded with married individuals with $z \geq R$. This reduces to $\Pi(k)$ using (1).

by virtue of $\partial V_1/\partial d = -1/(1-\eta)$, where $\varepsilon_z = \varepsilon_1$ if $z \in [\underline{z}, \bar{z}]$ and $\varepsilon_z = \varepsilon_0$ if $z = s$. Similarly, the surplus for the retailer is

$$\hat{S}(z) = \beta(1-\tau)d + \beta\rho(k-y) - \beta\rho(k) = \beta(1-\tau)d - \beta c(y,k)$$

(this also depends on k, but that is subsumed in the notation since k is constant across KW meetings). The generalized Nash bargaining solution is found by solving

$$\max_{y,d} S(z)^{\theta} \hat{S}(z)^{1-\theta} \text{ st } y \leq k. \tag{8}$$

Assuming the constraint $y \leq k$ does not bind, the solution satisfies the FOC

$$\begin{aligned} \beta c_y(y,k) &= (1-\tau)(1-\eta)\varepsilon_z v'(y) && (9) \\ (1-\tau)\beta d &= (1-\theta)(1-\tau)(1-\eta)\varepsilon_z v(y) + \theta\beta c(y,k). && (10) \end{aligned}$$

For singles, with $\varepsilon_z = \varepsilon_0$, we denote the outcome by (y_0, d_0); for married, with $\varepsilon_z = \varepsilon_1$, we denote it by (y_1, d_1) $\forall z \in [\underline{z}, \bar{z}]$. In either case, from (9), retail trade y is efficient except for taxes – i.e., marginal utility equals marginal cost iff $\tau = \eta = 0$ – and then (10) determines d as a function of θ.[8] Also, for future reference, the surplus for buyers conditional on z can be reduced to

$$S(z) = S_z = \frac{\theta\left[(1-\tau)(1-\eta)\varepsilon_z v(y_z) - \beta c(y_z,k)\right]}{(1-\tau)(1-\eta)}. \tag{11}$$

It is now a simple calculation to show:

Lemma 1 *Given $\alpha_0 \geq \alpha_1$ and $\varepsilon_0 \geq \varepsilon_1$, with at least one inequality strict, we have $y_0 > y_1$, $d_0 > d_1$, $S_0 > S_1$ and $A\alpha_0 S_0 > A\alpha_1 S_1$.*

Lemma 1 delivers sharp predictions, in part, because we have a labor-leisure choice and ℓ enters $\mathcal{U}$ linearly. Without this feature the model is far less tractable, unless $\mathcal{U}$

[8] The outcome depends on a buyer's marital status as an inevitable implication of generalized Nash bargaining, although this vanishes if $\theta = 1$. It also might vanish if z were private information, but that complicates things considerably. A more facile approach is to use price posting or price taking, instead of bargaining, but we want bargaining included in the Coasian frictions.

is linear in consumption as assumed in some related work – but that is inappropriate here since we want to know how results depend on whether marriage and markets are substitutes or complements. Lemma 1 pertains to the case where marriage and markets are substitutes in preferences and/or opportunities; to get the results for complements, one can simply reverse all the inequalities. We think the natural case is the one where they are substitutes, not only based on introspection, but on estimates in the literature.[9] In this case, singles get a higher expected surplus from the retail market, since they trade more on both the extensive and intensive margins, given $\alpha_0 > \alpha_1$ and $\varepsilon_0 > \varepsilon_1$. Also, notice $(y_z, d_z) = (y_1, d_1)\ \forall z \in [\underline{z}, \bar{z}]$, given the preference specification (3); more generally, Appendix A shows y_z is decreasing in z iff $u_{yz}(y, z) < 0$, which says people in better marriages buy less retail iff market and home goods are substitutes in the usual sense.

We now return to the retailer's problem. Inserting the bargaining solution, and assuming an interior solution, the FOC $\beta \Pi'(k) = 1$ becomes

$$1 + r = \rho'(k) - \frac{(1-\theta) A}{n} \left[\sigma \alpha_0 c_k(y_0, k) + (1-\sigma) \alpha_1 c_k(y_1, k) \right],$$

The LHS is the marginal cost of the investment k made in the previous AD market in terms of this period's numeraire. The first term on the RHS is a standard return on investment, while the second captures the expected cost reduction from bigger k when trading in KW, multiplied by $1-\theta$ because this must be shared with customers via bargaining – a typical holdup problem. To focus on marriage decisions, we can simplify retailers' problem by assuming inventories can be stored at the rate of time preference: $\rho(k) = (1+r) k$, or $c(y, k) = (1+r) y$. With this specification, there is no holdup problem, any $k \in [y_0, \infty)$ maximizes profit, and the constraint $y \le k$ never binds. Thus, we can assume $k = y_0$ and proceed ignoring $y \le k$.[10]

[9] Using different methods and different data, Rupert et al. (1995), McGrattan et al. (1997), and Aguiar-Hurst (2007) all find substitution elasticities between 1.5 and 2.0.

[10] A linear storage technology is useful for the same reason a linear technology for turning ℓ into x is useful – it lets us focus on marriage, rather than standard production and investment decisions. Notice also that $\Pi(k) \ge 0$, so that all n retailers are happy to participate in KW.

We now come to the heart of the model: The marriage decision. By definition of the reservation value, $V_1(d, R) = V_1(d, s)$, and because V_1 is linear in d, R is independent of d. Using (4)-(5), we reduce $V_1(d, R) = V_1(d, s)$ to

$$A\alpha_1 S(R) + V_3(0, R) + R = A\alpha_0 S(s) + V_3(0, s). \tag{12}$$

Before substituting in V_3, we use standard methods from search theory to write

$$\begin{aligned}
\int_R V_1(0, z) dF(z) &= [1 - F(R)] V_1(0, R) + \int_R \frac{\partial V_1(0, z)}{\partial z} [1 - F(z)] dz \\
&= [1 - F(R)] V_1(0, R) + \int_R \frac{[1 - F(z)] dz}{\beta (r + \delta)},
\end{aligned}$$

where the first equality uses integration by parts, and the second inserts $\partial V_1 / \partial z$, found by differentiating the value functions iteratively. Substituting this into V_3 and V_3 into (12), we arrive at

$$R = A\alpha_0 S_0 - A\alpha_1 S_1 + \frac{\lambda}{r + \delta} \int_R [1 - F(z)] dz, \tag{13}$$

where S_0 and S_1 are given in (11), simplified here because $\rho(k) = (1 + r) k$ implies $\beta c(y, k) = y$

To see what (13) means, consider the standard reservation wage equation from elementary job search theory (e.g., Rogerson et al. 2005),

$$R = b_0 - b_1 + \frac{\lambda}{r + \delta} \int_R [1 - F(w)] dw, \tag{14}$$

where b_0 (b_1) is the value of leisure plus government transfers when unemployed (employed). As is well understood, (14) equates the per period value of working at the reservation wage R to the net cost of working, given by difference $b_0 - b_1$, plus the opportunity cost, which is the appropriately capitalized expected return to continued search for a better wage. Similarly, (13) equates the value of marrying a reservation partner R to the difference between the value of entering the retail market single instead of married, $A\alpha_0 S_0 - A\alpha_1 S_1$, plus the opportunity cost, the return to continued search for a better partner.

Given R, for a single person, the probability of marriage – never more appropriately called *the hazard rate* – is $H = H(R) = \lambda[1 - F(R)]$. The steady state fraction of singles is then

$$\sigma = \sigma(R) = \frac{\delta}{\delta + H(R)}. \tag{15}$$

A statistic on which we focus, because this is what we have in the data discussed below, is the number of new marriages per period, $\phi = \phi(R) = \sigma(R) H(R)$ (to remember our notation, σ is a stock and ϕ is a flow). To define equilibrium, in addition to the above accounting relationships we need to take into account feasibility (market clearing). In KW and BC all trades are bilateral, so feasibility is automatic, while the AD feasibility condition is not important for what we do – it simply determines total employment $L = \sigma\ell(s) + (1-\sigma)\int_R \ell(z)dF(z)$, which we do not need to analyze the other variables of interest.[11] Putting the relevant pieces together leads to the following definition:

Definition 1 *A (steady state) equilibrium is a list (R, y_z, d_z, σ) such that: R solves the reservation equation (13); (y_z, d_z) solves the bargaining conditions (9)-(10) $\forall z$; and σ solves the steady state condition (15).*

3.2 Results

The envelope theorem implies the RHS of (13) is decreasing in R, so there is at most one solution. To ensure existence of an interior equilibrium, $R \in (\underline{z}, \bar{z})$, a sufficient condition is that the best possible marriage beats being single and being single beats the worst possible: $\bar{z} + A\alpha_1 S_1 > A\alpha_0 S_0 > \underline{z} + A\alpha_1 S_1$. Given this, we have:

Proposition 1 *There exists a unique equilibrium and it entails $R \in (\underline{z}, \bar{z})$.*

[11] Again, this follows from ℓ entering $\mathcal{U}$ linearly. For the record, AD market clearing is

$$x + nk = L + [n - \sigma A\alpha_0 - (1-\sigma)A\alpha_1]\,\rho(k) + (1-\sigma)A\alpha_1\rho(k - y_1) + \sigma A\alpha_0\rho(k - y_0).$$

Also, if $\mathbf{x} \in \mathbb{R}^n_+$ we can solve for it and $\mathbf{p} \in \mathbb{R}^n_+$ *independently* of equilibrium in KW and BC. This *dichotomy* obtains because of separability between $\mathbf{x}$ and (y, z); it is not true generally.

One can easily derive several results on marriage markets that parallel standard results on labor markets, including $\partial R/\partial \lambda > 0$, $\partial R/\partial r < 0$ and $\partial R/\partial \delta < 0$. Thus, increasing the arrival rate λ, or decreasing the rate at which one discounts the future of relationships, in terms of either r or δ, makes people more picky when it comes to tying the knot.[12] Much more novel are the effects on marriage of frictions in the retail market, our Coasian transactions costs, including parameters describing search (A, α_z), bargaining θ and taxation (τ, η), as well as preferences ε_z:

$$\begin{aligned}
\frac{\partial R}{\partial A} &= \frac{\alpha_0 S_0 - \alpha_1 S_1}{D}, \frac{\partial R}{\partial \alpha_0} = \frac{A S_0}{D}, \frac{\partial R}{\partial \alpha_1} = -\frac{A S_1}{D}, \\
\frac{\partial R}{\partial \theta} &= \frac{A\left(\alpha_0 S_0 - \alpha_1 S_1\right)}{D\theta}, \\
\frac{\partial R}{\partial \tau} &= \frac{\theta A\left(\alpha_1 y_1 - \alpha_0 y_0\right)}{D(1-\tau)^2(1-\eta)}, \frac{\partial R}{\partial \eta} = \frac{\theta A\left(\alpha_1 y_1 - \alpha_0 y_0\right)}{D(1-\tau)(1-\eta)^2}, \\
\frac{\partial R}{\partial \varepsilon_0} &= \frac{\theta A \alpha_0 v(y_0)}{D}, \frac{\partial R}{\partial \varepsilon_1} = -\frac{\theta A \alpha_1 v(y_1)}{D},
\end{aligned}$$

where $D = 1 + H/\left(r+\delta\right) > 0$. We conclude the following:[13]

Proposition 2 *Given $\alpha_0 \geq \alpha_1$ and $\varepsilon_0 \geq \varepsilon_1$, with at least one inequality strict, we have $\partial R/\partial A > 0$, $\partial R/\partial \alpha_0 > 0$, $\partial R/\partial \alpha_1 < 0$, $\partial R/\partial \theta > 0$, $\partial R/\partial \tau < 0$, $\partial R/\partial \eta < 0$, $\partial R/\partial \varepsilon_0 > 0$ and $\partial R/\partial \varepsilon_1 < 0$. Also, σ moves in the same direction as R, while H and ϕ move in the opposite direction, with respect to changes in these parameters.*

In terms of economics, the assumption on the α_z's and ε_z's is that marriage and markets are substitutes in terms of either preferences or opportunities. Now consider the retail search parameters. Higher α_0/α_1 increases the trading probability for singles relative to a married people, making marriage less attractive and increasing R. An

[12]It is easy to sign how σ and ϕ change with r; it is ambiguous what happens when δ increases, since this changes both the divorce and marriage rates, or when λ increases, since this raises the arrival rate but also increases R and the effect on H could go either way. As in job search, going back to Burdett (1981), one can impose restrictions to ensure certain reasonable results – e.g., $\partial\sigma/\partial\lambda < 0$ if $F(z)$ is log-concave – but we do not need any such restrictions for Proposition 2 below.

[13]We do not give a formal proof, since it is too easy. The results on R follow immediately from Lemma 1. Then, obviously, H moves in the opposite direction to R, and a little calculus shows σ moves in the opposite direction to H while ϕ moves in the same direction as H.

increase in overall search efficiency A increases R because singles are more invested in the retail market – they consume more on the extensive margin, given $\alpha_0 > \alpha_1$, and on the intensive margin, given $\varepsilon_0 > \varepsilon_1$. This is typical Coasian logic: individuals facing greater (lower) frictions in markets are more (less) inclined to bring activity in house. Similarly, as regards bargaining and taxation, a lower θ and higher τ or η all make individuals more inclined to marry. Again, this happens because markets and marriage are alternative ways to provide consumption, the way markets and firms are alternatives in Coase's original thesis.

Some of the results rely on specification (3): for an arbitrary $u(y,z)$, Appendix A shows, e.g., that we can still sign the impact of arrival rates, but not taxes. However, for any $u(y,z)$, everything in Proposition 2 holds as long as α_1 is not too big – i.e., married people are not too involved in KW. The results do not depend on details of the retailers' problem or the pricing mechanism. We leave as an exercise the derivation using Walrasian pricing, and instead, since we need it later, consider the Kalai's (1977) bargaining solution:

$$\max_{y,d} S(z) \text{ st. } S(z) = (1-\theta)\left[S(z) + \hat{S}(z)\right] \text{ and } y \leq k. \tag{16}$$

The FOC for y_z is the same as before, while the FOC for d_z changes to

$$\left[\theta(1-\tau)(1-\eta) + 1 - \theta\right]\beta d_z = (1-\eta)\left[(1-\theta)\varepsilon_z v(y_z) + \theta\beta c(y_z, k)\right], \tag{17}$$

which is different from (10), except in special cases like $\tau = \eta = 0$ or $\theta = 1$. Appendix B shows the qualitative effects are the same as in Proposition 2.

4 Extensions

We consider the following four issues: dating, love, divorce and money.

4.1 Dating

For this application, we reverse the order of the BC and KW markets, and interpret the latter as dating. Thus, when two singles meet in BC, z is *not* observed; rather, after participating the KW market as a pair, it is revealed and enjoyed in the next AD (one could also let them learn gradually, as in Jovanovic 1979). Once z is known the pair decides whether to marry. For a single in AD who did not date in the previous period, or dated but realizes $z < R$, the problem is the same as above, but for an individual that realizes $z \geq R$ we have

$$V_1(d, z) = z + \max_{x,\ell} \{U(x) - \ell + V_2(0, z)\} \text{ st } x = \ell (1 - \eta) - d + \Delta,$$

since now z is enjoyed in AD iff one gets married.

The BC value functions satisfy

$$\begin{aligned} V_2(0, s) &= \lambda \mathbb{E} V_3(0, \tilde{z}) + (1 - \lambda) V_3(0, s) \\ V_2(0, z) &= (1 - \delta) V_3(0, z) + \delta V_3(0, s). \end{aligned}$$

Notice the expectation in front of $V_3(0, \tilde{z})$ for those on dates, since $\tilde{z}$ is random. Also, in KW there are now married individuals, dating individuals and singles, with value functions satisfying

$$\begin{aligned} V_3(0, s) &= A\alpha_0 [\varepsilon_0 v(y_s) + \beta V_1(d_s, s)] + (1 - A\alpha_0)\beta V_1(0, s) && (18) \\ \mathbb{E} V_3(0, \tilde{z}) &= A\alpha_1 [\varepsilon_1 v(y_{\tilde{z}}) + \beta \mathbb{E} V_1(d_{\tilde{z}}, \tilde{z})] + (1 - A\alpha_1)\beta \mathbb{E} V_1(0, \tilde{z}) && (19) \\ V_3(0, z) &= A\alpha_1 [\varepsilon_1 v(y_z) + \beta V_1(d_z, z)] + (1 - A\alpha_1)\beta V_1(0, z). && (20) \end{aligned}$$

Using Nash bargaining, (9)-(10) and Lemma 1 still apply, and in particular, it does not matter that $\tilde{z}$ is not known on a date, since $(y_z, d_z) = (y_1, d_1)\ \forall z \in [\underline{z}, \bar{z}]$.

Following the procedure used to get (13), we have[14]

$$R = (1 - \lambda - \delta) (A\alpha_0 S_0 - A\alpha_1 S_1) + \frac{\lambda}{r + \delta} \int_R [1 - F(z)]\, dz. \quad (21)$$

All the derivatives of R with respect to parameters take the same sign as in the benchmark model. Hence, the results are robust to changing the order of markets, and

[14] We calculate $\mathbb{E}V_1(0, \tilde{z})$ as follows. If $z \geq R$ then $\partial V_1(0, z)/\partial z = 1/\beta(r + \delta)$, so $V_1(0, z) = V_1(0, R) + (z - R)/\beta(r + \delta)$ is linear in z. Then after integration by parts, $\mathbb{E}V_1(0, \tilde{z}) = V_1(0, R) + \int_R [1 - F(z)]\, dz/\beta(r + \delta)$.

adding uncertainty/learning. Although nothing especially dramatic happens here, working it out is a prerequisite for the extensions to follow.

4.2 Love

To this point, married individuals simply enjoy z as a "warm glow" from being with their partners. Here we follow Becker (1974) and consider love in terms *caring and sharing*. Using the timing in Section 4.1, for a single that did not meet anyone in the BC market the AD problem is as the same. For a single that was on a date, but realizes $z < R$ so there is no marriage, the AD problem is

$$V_1(\bar{d}, z) = \max_{x,\ell} \{U(x) - \ell + V_2(0, s)\} \text{ st } x = \ell(1-\eta) - \bar{d} + \Delta,$$

where $\bar{d} = (d + d')/2$ averages one's debt d and that of one's date d' – called "going Dutch." If they marry, however, they average their utilities and consolidate budgets

$$V_1(\bar{d}, z) = z + \max_{x,x',\ell,\ell'} \left\{ \frac{U(x) + U(x')}{2} - \bar{\ell} + V_2(0, z) \right\} \text{ st } \bar{x} = \bar{\ell}(1-\eta) - \bar{d} + \bar{\Delta},$$

where $\bar{\ell} = (d + d')/2$, $\bar{x} = (x + x')/2$ and $\bar{\Delta} = (\Delta + \Delta')/2$.

In the KW market, for a single who is not dating, the problem is also the same as before. For a single on a date, however,

$$\begin{aligned}
\mathbb{E}V_3(0, \tilde{z}) &= (A\alpha_1)^2 [\varepsilon_1 v(y_1) + \beta \mathbb{E}V_1(d_1, \tilde{z})] + (1 - A\alpha_1)^2 \beta \mathbb{E}V_1(0, \tilde{z}) \\
&\quad + A\alpha_1(1 - A\alpha_1) \left[\frac{\varepsilon_1 v(y_1)}{2} + \beta \mathbb{E}V_1 \left(\frac{d_1}{2}, \tilde{z} \right) \right] \\
&\quad + (1 - A\alpha_1) A\alpha_1 \left[\frac{\varepsilon_1 v(y_1)}{2} + \beta \mathbb{E}V_1 \left(\frac{d_1}{2}, \tilde{z} \right) \right],
\end{aligned}$$

assuming pairs search for retailers independently (one could change that). Thus,

$$\mathbb{E}V_3(0, \tilde{z}) = A\alpha_1 [\varepsilon_1 v(y_1) + \beta \mathbb{E}V_1(d_1, \tilde{z})] + (1 - A\alpha_1) \beta \mathbb{E}V_1(0, \tilde{z}). \tag{22}$$

For a married individual in the KW market, a similar calculation leads to almost the same result, the only difference being that z is known,

$$V_3(0, z) = A\alpha_1 [\varepsilon_1 v(y_1) + \beta V_1(d_1, z)] + (1 - A\alpha_1) \beta V_1(0, z). \tag{23}$$

Notice (22)-(23) are identical to (19)-(20) in the Section 4.1, and hence the models generate the same predictions. This confirms Becker's (1974, fn. 9) intuition that "when the degree of caring becomes sufficiently great, behavior becomes similar to that when there is no caring." Simply put, when two individuals fully internalize each others' well-being, it is impossible for one to do anything to make the other happier. If one increases ℓ so the other can reduce ℓ', say, the increase in leisure gives the latter more utility, but this is exactly offset by the loss of leisure by the former. As interesting as this may or may not be, the main implication for our purposes is that Proposition 2 holds exactly as stated.

4.3 Divorce

In the empirical work below we look at flows into partnerships (marriage), but not flows out (divorce). Why? First, in the baseline model, the divorce hazard δ is exogenous, but since the stock σ is endogenous, so is the flow $\delta(1-\sigma)$. It is easy to show the following: When the frictions change so that R decreases – i.e., so that people are more inclined to marriage – one may naively think the divorce flow $\delta(1-\sigma)$ should go down; it actually goes up. To see why, note that in steady state the flows in and out are equal, $\delta(1-\sigma) = H\sigma$. So, if some change makes people flow into marriage at a higher rate, the stock σ adjusts until the flow out is also higher. The is also true when we endogenize the divorce hazard δ, in a generalization of Section 4.1, by having married individuals learn about each other gradually, or, alternatively, change their mind about each other, over time.[15]

The point is that even *if* the divorce hazard falls, the flow $\delta(1-\sigma)$ generally does not. This is relevant because it suggests paying less attention to divorce than marriage, which we want to do anyway, because we have less divorce data, and we trust it less. We trust the divorce data less because by the time two people get

[15] See Burdett and Wright (1998) for the method; the simple idea is to generalize our model the same way Mortensen and Pissarides (1994) generalize Pissarides' baseline model. As they point out, they do this since they want to study job destruction as well as job creation.

divorced, they may well have been estranged for a long time. Even if they are living apart, it can take years for a divorce to become official in the records. Of course, the marriage records are not 100% pure in this regard, since couples can live together before getting married, but at least in some of our micro data we can control for this by treating common law couples as married. Whatever data issues arise with marriage, they are probably worse for divorce. Now, we are *not* suggesting that future work should ignore divorce – just that it helps keep the current project manageable to concentrate for now on flows into and not out of marriage.

4.4 Money

For reasons that have to do with empirical work, here we briefly sketch a monetary version of the model.[16] Since money only has a role when credit is imperfect, assume now that individuals are *anonymous* in the KW market. Hence, they can renege on debt with impunity, and a medium of exchange becomes essential. This is role is played by fiat money. The money supply M grows at gross rate π, which equals the gross inflation rate in stationary equilibrium. Changes in M can be accomplished using lump sum transfers if $\pi > 1$ or taxes if $\pi < 1$, or alternatively, using changes in government spending on the AD commodity x (the results are the same for the variables on which we focus). Also, here we abstract from love and dating, and return to the baseline timing where BC follows KW follows AD.

For an individual in AD with m dollars and marital status z,

$$V_1(m,z) = \max_{x,\ell,\hat{m}} \{U(x) - \ell + V_2(\hat{m},z)\} \text{ st } x + \psi\hat{m} = \ell(1-\eta) + \psi m + \Delta,$$

where ψ is the AD price of money in terms of x, and the FOC $\partial V_2/\partial\hat{m} = \psi/(1-\eta)$ implies $\hat{m}$ is independent of m. In the KW and BC markets, for a single,

$$\begin{aligned} V_2(m,s) &= A\alpha_0 [\varepsilon_0 v(y_s) + V_3(m - p_s, s)] + (1 - A\alpha_0)V_3(m,s) \\ V_3(m,s) &= \lambda \int_R \beta V_1(m,z)dF(z) + [1 - \lambda + \lambda F(R)] \beta V_1(m,s) \end{aligned}$$

[16] For more details, see surveys by Willaimson-Wright (2010) and Nosal-Rocheteau (2011).

where p_z denotes the dollars paid for y_z in KW. The equations for a married individuals are similar. Hence, $\partial V_3(m,z)/\partial m = \beta\psi_+/(1-\eta)$ where ψ_+ is the value of money in the next AD market. Bargaining in the KW market is similar to the perfect-credit model, except that we add the constraint $p \le \hat{m}$, which always binds in equilibrium – at least, as long as the nominal interest rate, defined below, is not 0. Here we use Kalai bargaining, which reduces the algebra a lot compared to Nash without affecting the substantive results (see fn. 17).

Kalai bargaining now yields a y_z that satisfies $\beta\psi_+\hat{m} = (1-\eta)\,g(y_z)$, where

$$g(y_z) = \frac{(1-\theta)\varepsilon_z v(y) + \theta y}{\theta(1-\tau)(1-\eta) + 1 - \theta}. \tag{24}$$

The FOC for $\hat{m}$ from AD can be written

$$\frac{\psi}{1-\eta} = A\alpha_z\varepsilon_z \frac{v'(y_z)}{g'(y_z)}\frac{\beta\psi_+}{1-\eta} + (1 - A\alpha_z)\frac{\beta\psi_+}{1-\eta},$$

using $dy_z/d\hat{m} = \beta\psi_+/(1-\eta)\,g'(y_z)$. Defining the nominal rate i via the Fisher equation, $1+i = \pi/\beta$, this collapses to $i = A\alpha_z\mathcal{L}(y_z)$, where

$$\mathcal{L}(y_z) = \frac{\varepsilon_z v'(y_z)}{g'(y_z)} - 1 = \theta\frac{(1-\tau)(1-\eta)\varepsilon_z v'(y_z) - 1}{(1-\theta)\varepsilon_z v'(y_z) + \theta}. \tag{25}$$

A stationary monetary equilibrium is given by a solution to $i = A\alpha_z\mathcal{L}(y_z)$. It is not hard to show this exist iff $i < \bar{i} = A\alpha_0\theta(1-\tau)(1-\eta)/(1-\theta)$, and when it exists it is unique because $\mathcal{L}'(y_z) < 0$.

In terms of economic results, it is easy to check $y_0 > y_1$ and $\hat{m}_0 > \hat{m}_1$ if $\varepsilon_0 \ge \varepsilon_1$ and $\alpha_0 \ge \alpha_1$ with one inequality strict – i.e., singles buy more retail goods and hence hold more money when marriage and markets are substitutes in terms of preferences and/or opportunities. It is also easy to check $\partial\hat{m}_z/\partial i < 0$ and $\partial y_z/\partial i < 0$ – i.e., higher nominal interest or inflation rates decrease money balances and retail trade for everyone. The generalization of (13) is

$$R = A\alpha_0 S_0 - A\alpha_1 S_1 - ig_0 + ig_1 + \frac{\lambda}{r+\delta}\int_R [1 - F(z)]\,dz,$$

where $g_z = g(y_z) = \beta\psi_+\hat{m}_z/(1-\eta)$. Compared to the benchmark, when individuals choose R they now have to take into account the cost of carrying money, ig_z. In terms of frictions, the effects are qualitatively the same as Proposition 2 (see Appendix B). We also have a new effect, $\partial R/\partial i = (g_1 - g_0)/D$, which we highlight as follows:

Proposition 3 *A unique stationary monetary equilibrium exists iff $i < \bar{\imath}$. In monetary equilibrium $\partial R/\partial i < 0$ iff $g_0 > g_1$, a sufficient condition for which is $\varepsilon_0 \geq \varepsilon_1$ and $\alpha_0 \geq \alpha_1$ with at least one inequality strict. Also, σ moves the same direction as R, while H and ϕ move in the opposite direction, with respect to changes in i.*

The key prediction is that as long as $g_0 > g_1$ – which means being single is cash intensive, which is the case as long as marriage and markets are substitutes – inflation like any other tax makes individuals more inclined to move economic activity out of the market and into the home. In this way, inflation encourages marriage. This conclusion survives various generalizations, including integrating cash and credit models (as in Dong 2010), and using other trading mechanisms in the retail market.[17] Also, in the basic model we can add uncertainty, learning and endogenous divorce, change the timing, or incorporate alternative notions of love. The theoretical predictions are robust. We now move to empirical analysis.

5 Evidence

We consider two types of information. First, under the maintained assumption that marriage and markets are substitutes, as some empirical work suggests (recall fn. 9),

[17] For Nash bargaining, the algebra is messier, as one can see from comparing (24) and (25) to

$$\begin{aligned} g(y_z) &= \frac{\theta y_z \varepsilon_z v'(y_z) + (1-\theta)\varepsilon_z v(y_z)}{(1-\tau)(1-\eta)\theta\varepsilon_z v'(y_z) + 1 - \theta} \\ \mathcal{L}(y_z) &= \frac{\theta\left[(1-\tau)(1-\eta)\varepsilon_z v'(y_z) - 1\right]\varepsilon_z v'(y_z)\left[(1-\tau)(1-\eta)\theta\varepsilon_z v'(y_z) + 1 - \theta\right] + \Gamma}{\left[(1-\tau)(1-\eta)\theta\varepsilon_z v'(y_z) + 1 - \theta\right]\varepsilon_z v'(y_z) - \Gamma} \end{aligned}$$

where $\Gamma = \theta(1-\theta)\left[(1-\tau)(1-\eta)\varepsilon_z v(y_z) - y_z\right]\varepsilon_z v''(y_z)$. One can still show $\partial R/\partial i < 0$ iff $g_0 > g_1$, and $g_0 > g_1$ holds under the same conditions, but there is one technicality: we cannot sign $\mathcal{L}'$ with Nash bargaining, while we know $\mathcal{L}' < 0$ with Kalai bargaining. Still, the method in Wright (2010) gets around the problem, and the results go through.

theory predicts singles use markets and hence money more than otherwise similar married people. We examine micro evidence on this. Second, given singles hold more money, theory predicts inflation like other market frictions increases the propensity to marry. We examine macro data on marriage flows across countries and time, to see how they relate to inflation, taxation and other variables.[18]

5.1 Micro

There is some existing work that bears on the idea that being single is cash intensive, including Klee's (2008) study of how people pay using US grocery-store scanner data. These data do not include demographic information, of course, so she compares payment patterns across census tracts. Although not primarily interested in the effects of marital status, she reports that after controlling for the number of items purchased, their values, income, age and other factors, marriage – i.e., being in a census tract with more married people – significantly decreases the probability of using cash by 0.466 and increases the probability of using credit cards by 0.249.[19] Also, the probability of using cash (credit) increases (decreases) on Friday and Saturday, consistent with the idea that going out is cash intensive, and given single people go out more this also suggests they use more money. Klee considers other explanations for the weekend effect (e.g., people get paid on Friday), but concludes "the type of items bought on Friday and Saturday – beer and cigarettes in particular – are more likely to be purchased with cash," suggesting to us that dating is cash intensive. Her bottom line is "census tracts with a higher percentage of married households are less likely to use cash," consistent with the hypothesis in question.[20]

[18] One can interpret these exercises as "tests" under the maintained hypothesis that marriage and markets are substitutes; alternatively, one can take the model as given and interpret the data as indicating the extent to which marriage and markets are substitutes.

[19] Klee has data on other payments methods, too. For the record, marriage increases the probability of using checks and debit cards by the relatively small 0.115 and 0.102.

[20] We briefly mention some other related work. Liu (2008) regresses cash holdings on income, expenditure and demographics, and finds a dummy for married is significantly negative. Duca and Whitesell (1995) find, after controlling for other factors, that married people are significantly more likely to have credit cards, and have lower money demand at least as measured by checking deposits.

Moving to our own analysis, which can be focused more directly on the question at hand, consider first the Italian Survey of Household Income and Wealth, which collects information on currency holdings and spending from several thousand individuals every two years between 1993 and 2004.[21] Tables 1 and 2 present summary statistics (Tables are at the end). Table 1a reports currency holdings in each year for households with $N = 1$ adult, which we take to be single people, as well as households with $N = 2$ and $N = 3$. Currency is on average 54% higher for individuals in households with $N = 1$ than $N = 2$. Although our theory focused on $N = 1$ or 2, we also report that adults in households with $N = 1$ hold about double the money held by those with $N = 3$. These numbers do not control for expenditure, however, which may be important if single and married people differ in their spending behavior for other reasons. Table 1b corrects for this by dividing currency per adult by expenditure per adult (i.e., total household expenditure over N). Currency per adult over expenditure per adult is on average around 23% higher for people in households with $N = 1$ than $N = 2$, and 28% higher for those with $N = 1$ that $N = 3$.

We tried a number of different ways to investigate the robustness of these findings. Table 1c divides currency per adult by cash (instead of total) expenditure per adult, which changes the numbers to 19% and 29%. Tables 2a-c report the same measures as Tables 1a-c restricting the sample to those individuals with bank accounts, which somewhat reduces the number of observations, but makes sense to the extent that those without bank accounts may be different in ways the theory does not take into account (e.g., perhaps these individuals are involved in illegal activity, although this is speculation). This changes the numbers slightly, but not a lot. We also parsed the sample by distinguishing between households with no bank, with a bank but no

Stavins (2001) finds married people are significantly more likely to use electronic payments, after controlling for age, income and homeownership. Fusaro (2008) finds singles have 40% to 50% higher ATM withdrawals, after controlling for income. While none of this is overwhelming, it is at least consistent with the idea that singleness is cash intensive.

[21] Francesco Lippi was very generous sharing this data with us and helping us understand it. For more on using it, see Alvarez and Lippi (2009) Lippi and Secchi (2009).

access to an ATM, and with a bank and access to ATM; we also divided cash by durable (instead of total) expenditure. The results were broadly similar. In terms of statistical confidence, the standard deviations are sufficiently low that clearly these differences are highly significant. Overall this evidence is very much consistent with the underlying hypothesis: at least in Italy, being single is cash intensive.

Consider next the 2009 Survey of Consumer Payment Choice by the Federal Reserve Bank of Boston, which contains data on individual cash in the wallet and total cash, as well as income and demographics.[22] Tables 3 reports numbers for the following categories of marital status: single; divorced or separated; widowed; nonmarried (the sum of the first three); and married plus common law. Column 1 shows that without controlling for income or expenditure, married and divorced individuals have less cash in the wallet than single or widowed individuals. Column 2 adjusts cash in wallet by annual household income in thousands. By this measure, married have substantially less cash in the wallet than nonmarried individuals. This may be an over-correction, however, since it divides individual cash holdings by household income. Column 3 rectifies this by dividing household income by the number of adults (individuals over age 15), giving cash per person over income per person. This again indicates that married people hold less cash in wallet: by this measure, nonmarried hold around 68% more than married people.

Columns 4-6 redo 1-3 using total (not just in the wallet) cash holdings. The same pattern emerges, with Column 6 indicating that after controlling for household size and income nonmarried hold around 127% more money than married people. Columns 7-12 in Table 3 restrict the sample by eliminating individual observations with cash in the wallet over $1,000 or total cash holding over $10,000. Again this seems reasonable to the extent that people with that much money may be engaged in activities not in the model (e.g., illegal activities). In this restricted sample, Columns 9 and 12 show that nonmarried hold around 67% more money in their wallets, and

[22] See Schuh and Stavins (2010) for more discussion of the data.

around 141% more money in total, than married individuals. Hence, in America, like Italy, being single is cash intensive, and this is true not only when we consider cash on hand, but also money in the proverbial cookie jar or elsewhere.

Consider next the Bank of Canada's 2009 Methods of Payment Survey, which also contains information on currency holdings, spending, income and demographics from 6,868 respondents in a Survey Questionnaire, plus a subsample of 3,465 individuals in a 3-day Diary Instrument providing details on all transactions.[23] Table 4 provides statistics from the Survey Questionnaire for the same categories of marital status used with Boston Fed data. Columns 1-3 are cash holdings, cash holdings divided by annual household income in thousands and cash holdings divided by household income adjusted by the number of adults (in this case, individuals over age 18). Columns 4-6 redo 1-3 using cash spending rather than cash holding. The numbers continue to indicate that married individuals hold the least cash, although the differences are not as big. By the measure in Columns 3 and 6, nonmarried hold on average around 7% more cash than married and after controlling for household size and income, and nonmarried spend approximately 1/3 more cash. Columns 7-12 of Table 4 restrict the sample by eliminating individual observations where cash holding or weekly cash expenditure exceeds $1,000. Columns 9 and 12 indicate that, in the restricted sample, nonmarried hold around 40% more cash than married, and spend around 48% more.

Arguably the Diary Instrument is more reliable than the Survey, even if the sample is smaller. The Diary numbers are reported in Table 5. Columns 3 and 6 indicate that average cash holding is about 1/3 greater for nonmarried people, and cash spending 2/3 greater, after appropriately controlling for household income and size. Columns 9 and 12 show similar results after again eliminating observations above $1,000. Most of the relevant differences – e.g., either cash holdings or spending, normalized by household income, for married vs. nonmarried – are again highly significant in both the Survey and Diary data, without or with truncating observations over $1,000. On

[23] See Arango and Welte (2012) for more on this dataset.

the whole, these data constitute strong evidence in favor of the hypothesis that being single is cash intensive in Canada, too.[24]

We also report OLS regression results on the Canadian data.[25] The LHS variable is cash holding (or spending) divided by household income, normalized by household size iff dummies for size are not included on the RHS. In addition to household size, RHS variables include age, education etc., plus dummies for marital status. To keep the amount of information manageable, results are only reported using two marital states: we group single, divorced, separated and widowed as nonmarried; and group common law together with married. We give results for both the Survey and Diary excluding observations with cash holding or spending above $1,000. Tables 6 and 7 use the Survey and Diary data, resp., and yield fairly similar estimates. To understand the units, the average married woman in the Diary sample, after eliminating observations over $1,000, holds around $77, which yields 2.825 after dividing by individual annual income (Table 5b, Column 7). So she has annual income $27,349. A coefficient on the nonmarried dummy of 1, which is close to the estimates, means that if she were not married, she would hold 1/10 of 1% more in terms of annual income, which is an extra $27, or a 35% increase.

The key result for our purposes is this: for both cash holding and spending, no matter which of the various runs one considers, the coefficient on the unmarried dummy is positive and significant, usually at the 1% level. Also of interest is the finding that the unemployed and less educated tend to use more cash. We emphasize, however, that the reason the unmarried dummy is significant is *not* that being single is correlated with being unemployed or less educated, since the relevant coefficient is still positive and significant when unemployment and education are on the RHS.

[24] The Bank of Canada data also have payment information that can be analyzed as in Klee (2008). A quick summary from results in Arango et al. (2011) is this: the probabilities of using cash in any transaction for single and married people are 55% and 48%, resp., and the probabilities of using credit cards are 20% and 25%, resp.

[25] We ran similar regressions on the Boston Fed data (not reported). The results were similar, but not quite as strong.

Also, males use more cash, although this is not always significant. Finally, when we do not divide cash by household size on the LHS, but instead include size dummies on the RHS, individuals from bigger households use less cash, although again this is not always significant. While there is more one can do with the data, on this issue, we are prepared to rest our case: all this evidence makes it hard not to agree that being single is cash intensive.

5.2 Macro

Elementary economics tells us that market frictions encourage people to substitute out of markets and into home production, and as long as household production is facilitated by household formation, this encourages marriage. Since being single is cash intensive, as documented above, inflation leads to more marriage (Proposition 3). The logic is even simpler for the effects of sales or income taxes (Proposition 2). These effects are more likely to be operative to the extent that marriage and markets are good substitutes, as empirical work suggests (fn. 9). Given this, we examine marriage rates in a panel of countries over the last half century, taking into account the effects of inflation and taxation, as well as growth and unemployment.

Table 8 provides a summary of the data. We use number of marriages and population data to compute the marriage flow ϕ (marriages per 1000 population), from 1950 to 2004, for all countries in the United Nations Common Database (UNCDB). There are 275 countries in total in the UNCDB – a lot more than there are at any point in time, since many come into or go out of existence over the period. Given missing observations and other problems, we have at most 152 usable countries, and often far fewer, depending on what other variables we include in the regressions. Inflation is available for many of these countries, using either the CPI or GDP deflator, from International Financial Statistics (IFS). Our GDP deflator data covers around 150 countries starting in 1970, while our CPI series is longer but has fewer countries, so we report results for both. We have OECD consumption tax rates every four years before 1990, and every two years up to 2000. Since this leaves a lot of gaps, we also use the tax series constructed in Mendoza et al. (1997), hereafter the Mendoza taxes. A big advantage of the Mendoza data is that they include labor and capital, as well as consumption, taxes; the down side is that they are available for only 18 countries.[26] In general, while taxation may be at least as important as inflation, the advantage of inflation is that the data is readily available for many more countries and years.

Although we did not explicitly incorporate aggregate changes in output or unemployment in the formal model, it would not be hard to do so, and might be interesting in future work. And even if one does not have strong priors on the effects of unemployment or output growth, one wants to control for these factors empirically for the following reason. Whatever relation one might find between marriage, on the one hand, and inflation or taxation or any other independent variable, on the other, it could be dismissed by arguing that any independent variable like inflation or taxation is merely standing in for changes in output or unemployment that are correlated with it. Hence, we include in the empirical analysis real output growth and unemployment rates. Our output data is also from IFS. For unemployment, there are various sources, including OECD Labor Force Statistics, UN and IFS data. The OECD data are available for a small subset of countries, while the others are available for around 70 countries. We tried them all, but in the interests of space we report results only for IFS unemployment (the main conclusions were similar for the others).

Since we have a panel, we use GLS. Table 9 reports the results of a first cut at the data, where we run marriage rates on GDP deflator and CPI inflation rates in Columns (1)-(4) and Columns (5)-(8), resp. In each case, the first Column has only inflation and inflation squared on the RHS, where the latter is included because one should clearly expect a nonlinear relationship, given that there are some observations of extremely high inflation rates, and marriage rates are bounded above. Then the

[26] These countries are: US, UK, Austria, Australia, Belgium, Denmark, France, Germany, Italy, New Zealand, Netherlands, Norway, Sweden, Switzerland, Canada, Japan, Finland and Spain.

second Column includes output growth, the third includes unemployment, and the fourth includes both. Table 9 does not include taxes, which means we can use a large sample, including as many as 3,453 observations across 67 to 152 countries, depending on what is on the RHS. In this Table, there is really not much going on: the coefficients on inflation may be positive, but they are tiny, and usually not significant; output growth does very little; and the only significant result is that unemployment reduces marriage. But do not be too discouraged – as we said, this is only a first cut.

Table 10 redoes Table 9 including OECD consumption taxes on the RHS, which reduces the number of countries and observations. Still the negative effect of unemployment is there, and now output sometimes shows up positive and significant. Also, consumption taxes seem to reduce marriage. We come back to taxes later; for now, the result on which we focus is that the inflation coefficients now are positive and often highly significant. Table 11 repeats the exercise using Mendoza taxes, reducing the number of countries even more. Again we postpone discussion of fiscal variables to concentrate on inflation. In Table 11 the inflation effect is positive, and usually highly significant, at least when we use the GDP deflator. To see if the differences between Table 9 and Table 11 are due mainly to adding taxes or changing the sample, Table 12 runs the model without taxes on the Mendoza countries, which tend to be more advanced (fn. 26). The results are much stronger here – in contrast to Table 9, basically everything is significant in Table 12, even though there are fewer observations. In particular, in all runs the coefficients on inflation, and usually also on inflation squared, take the expected signs and are highly significant. For the countries in the Mendoza sample, without controlling for taxes the effect of inflation is clear; and if the results are somewhat weaker when taxes are included, in Table 11, this may be due at least in part to having fewer observations.

One usually takes more seriously any given model's predictions about some components of the data than others, and we tend to think our theory applies better over longer horizons. In studying business cycles, one considers the objects of interest to be deviations from slowly moving trends, defined using an HP filter or some other smoothing procedure, with the idea presumably being that some models are more useful for thinking about high- than low-frequency phenomena. Since our model seems relatively useful for thinking about lower frequencies, the objects of interest are not the deviations but the trends themselves. Table 13 shows results using HP trends on the RHS, without taxes, so that we can use the biggest set of countries and years. The results are much stronger than those for the raw data in Table 9, and in particular, the effect of inflation is usually highly significant. Table 14 redoes Table 13 including taxes, which reduces the number of countries and observations a lot, but still inflation has a significant positive effect. Table 15 runs the model without taxes on the Mendoza countries using the smoothed data. The effects of inflation continue to be consistently positive and highly significant. And to show the exact smoothing procedure does not matter much, Table 16 redoes Table 15 using five-year moving averages instead of the HP filter, with very similar results.

Our conclusions from all this are the following. First, output growth (unemployment) tends to encourage (discourage) marriage. We find this interesting. Second, inflation performs as expected based on Proposition 3, especially when we smooth the data to focus on lower frequencies. We find this satisfying. Third, given Proposition 2, we find the effects of consumption and labor taxes puzzling, since it is unclear why taxes should decrease marriage. One answer might involve a model with multiple market goods, some of which are substitutes for home production – e.g., food – while others are complements – e.g., consumer durables. For the sake of argument, suppose the former tend to be purchased with cash and the latter on credit. Then inflation encourages home production and marriage as agents substitute home cooking for restaurant meals, while at the same time taxation discourages marriage since it raises the cost of durables used in the home. We do not think this story is contrived, although one needs to work out the details, and that is left for future research. Another avenue to consider is that in some countries tax codes have a direct impact on the cost of getting married, as discussed by Chade and Ventura (2002) and references therein. For now, the main point of looking at the aggregate data was to see if inflation and taxation have any impact on marriage. It seems that they do.

One can also look at individual countries, although there are so many that a careful analysis is beyond the scope of this project. But, as a teaser, we can show some information that readers may find useful. Figures 1-3 provide scatter plots of marriage and inflation for the Mendoza countries, with the right panels using raw data and the left using data smoothed by the HP filter.[27] Regression lines are shown in each case, although one hardly needs these to see a clear positive relationship in most countries.[28] We do not want to make too much of these plots, but it would seem wrong to not show them. Also, we are aware that the 18 plots do not constitute 18 independent pieces of information, since many of these countries have had similar inflation experiences over the last half century, as well as participating in more or less similar events that could affect marriage – e.g., changes in social customs, or demographic developments like baby boomers coming of age at similar times. Still, the plots convey information.

While a complete country-by-country analysis must wait, we report results for the US and Canada in Tables 17-20. For the US, when taxes are not included, inflation has a highly significant positive impact on marriage. Once taxes are included, however, the effect is reduced to 0, if not negative, although again this may be due to the reduction in sample size. But what is remarkable is that in the US the effects of taxation are very much in line with theory: the relevant coefficients are all positive

[27] The points are color-coded by decade: red – 1950s; blue – 1960s; purple – 1970s; green – 1980s; and black – 1990s. This allows one to trace out the history of inflation and marriage from the scatter for each country about as easily as looking at the time series.

[28] The exceptions include Denmark, where the relationship goes the "wrong" way, and a few others, where it is basically flat. Fynn Kydland suggests a potentially relevant feature of Denmark is that many people live common law, so perhaps the Danish marriage data are not so reliable.

and usually highly significant. Coasian logic thus works well for the US, even if fiscal seem more important than monetary considerations. For Canada, the coefficients are positive for consumption and capital taxes, but negative for labor taxes. It is easier to think inflation has the predicted effect in Canada – for smoothed data, the relevant coefficients are positive and highly significant in 5 out of the 8 runs. If inflation effects are harder to see in Canada and the US, it may be because these countries do not have so much inflation, or variation in inflation, compared to the world at large. This all seems worth additional study, but also must be left for future work.

6 Conclusion

Coasian theory recognizes that markets and other ways of organizing economic activity coexist, and the choice to use one or the other depends on costs and benefits. The use of the market entails frictions, including search and bargaining costs, taxation and inflation. When these are big, it is desirable to bring certain activities in house by substituting out of market and into household production. Given the latter is facilitated by household formation, this increases marriage. We formalized this in a dynamic general equilibrium model, where agents trade goods, labor and assets, plus search for partners. Although the setup has a lot of detail, it simplifies nicely, and delivers very clean predictions. We think the model stands on its own as a contribution to the pure theory of marriage – and perhaps to monetary economics. But we also presented some empirical work, where we found a positive relationship between inflation and marriage in the macro data, which makes sense in light of the micro evidence that being single is cash intensive. The effects of taxation are less clear, in general, although they are there for the US. More can be done. We wanted here mainly to illustrate that one can build dynamic general equilibrium models with frictional marriage and goods markets, and to suggest this may be interesting, not only in theory, but also empirically.

Appendix A

Here we consider a general utility function $u(y,z)$, rather than (3). In the KW market, the value functions and trading surpluses satisfy

$$\begin{aligned}
V_2(0,s) &= A\alpha_0\left[u(y_s,s)+V_3(d_s,s)\right]+(1-A\alpha_0)\left[u(0,s)+V_3(0,s)\right] \\
V_2(0,z) &= A\alpha_1\left[u(y_z,z)+V_3(d_z,z)\right]+(1-A\alpha_1)\left[u(0,z)+V_3(0,z)\right] \\
S(z) &= u(y,z)-u(0,z)-\frac{\beta d}{1-\eta} \\
\hat{S}(z) &= \beta(1-\tau)d-\beta c(y,k).
\end{aligned}$$

Nash bargaining (Kalai is similar) in the baseline economy implies

$$\begin{aligned}
\beta c_y(y,k) &= (1-\tau)(1-\eta)\,u_y(y,z) \\
(1-\tau)\,\beta d &= (1-\theta)(1-\tau)(1-\eta)\left[u(y,z)-u(0,z)\right]+\theta\beta c\,(y,k)\,.
\end{aligned}$$

From this it is easy so verify $\partial y/\partial z \simeq u_{yz}(y,z)$, as claimed in the text.

Next, to derive the reservation equation, use $V_1(0,R)=V_1(0,s)$ to get

$$A\alpha_1 S(R)+V_3(0,R)+u(0,R)=A\alpha_0 S(s)+V_3(0,s)+u(0,s).$$

As always, we have

$$\begin{aligned}
V_3(0,R) &= \delta\beta V_1(0,s)+(1-\delta)\beta V_1(0,R), \\
V_3(0,s) &= \left[1-\lambda+\lambda F(R)\right]\beta V_1(0,s)+\lambda\beta\int_R V_1(0,z)dF(z),
\end{aligned}$$

where in this case integration by parts yields

$$\int_R V_1(0,z)dF(z)=\left[1-F(R)\right]V_1(0,R)+\int_R\frac{A\alpha_1 S'(z)+u_z(0,z)}{\beta(r+\delta)}\left[1-F(z)\right]dz.$$

Combining these expressions, we get the generalized version of (13)

$$u(0,R)+A\alpha_1 S(R)=u(0,s)+A\alpha_0 S(s)+\frac{\lambda}{r+\delta}\int_R\left[u_z(0,z)+A\alpha_1 S'(z)\right]\left[1-F(z)\right]dz$$

where

$$S(z)=\frac{\theta\left\{(1-\tau)(1-\eta)\left[u(y_z,z)-u(0,z)\right]-\beta c(y_z,k)\right\}}{(1-\tau)(1-\eta)}.$$

Generalizing Proposition 1, a sufficient condition for equilibrium with $R\in(\underline{z},\bar{z})$ is now $u(0,\bar{z})+A\alpha_1 S(\bar{z})>u(0,s)+A\alpha_0 S(s)>u(0,\underline{z})+A\alpha_1 S(\underline{z})$. In terms of

Proposition 2, we have

$$\begin{aligned}
\frac{\partial R}{\partial \alpha_0} &= \frac{AS(s)}{D\left[u_z(0,R)+A\alpha_1 S'(R)\right]} \\
\frac{\partial R}{\partial \alpha_1} &= \frac{-AS(R)+\frac{\lambda A}{r+\delta}\int_R S'(z)\left[1-F(z)\right]dz}{D\left[u_z(0,R)+A\alpha_1 S'(R)\right]}.
\end{aligned}$$

Inserting $S'(z)$, the term multiplying $D>0$ in the denominator simplifies to $u_z(0,R)+A\alpha_1 S'(R) = (1-A\alpha_1\theta)\,u_z(0,R)+A\alpha_1\theta u_z(y_R,R)>0$. Hence, $\partial R/\partial\alpha_0>0$. As for $\partial R/\partial\alpha_1$, since $S'(z)\simeq u_{yz}(y,z)$, it is negative at least when y and z are substitutes. We also have

$$\begin{aligned}
\frac{\partial R}{\partial A} &= \frac{\alpha_0 S(s)-\alpha_1 S(R)+\frac{\lambda\alpha_1}{r+\delta}\int_R S'(z)\left[1-F(z)\right]dz}{D\left[u_z(0,R)+A\alpha_1 S'(R)\right]} \\
\frac{\partial R}{\partial \theta} &= \frac{A\left[\alpha_0 S(s)-\alpha_1 S(R)\right]+\frac{\lambda A\alpha_1}{r+\delta}\int_R S'(z)\left[1-F(z)\right]dz}{D\left[u_z(0,R)+A\alpha_1 S'(R)\right]\theta} \\
\frac{\partial R}{\partial \tau} &= \frac{\theta\beta A\left[\alpha_1 c\left(y_R\right)-\alpha_0 c\left(y_s\right)\right]+\frac{\theta\lambda A\alpha_1}{r+\delta}\int_R u_{yz}(y_z,z)\frac{\partial y_z}{\partial\tau}\left[1-F\left(z\right)\right]dz}{D\left[u_z(0,R)+A\alpha_1 S'(R)\right](1-\tau)^2(1-\eta)} \\
\frac{\partial R}{\partial \eta} &= \frac{\theta\beta A\left[\alpha_1 c\left(y_R\right)-\alpha_0 c\left(y_s\right)\right]+\frac{\theta\lambda A\alpha_1}{r+\delta}\int_R u_{yz}(y_z,z)\frac{\partial y_z}{\partial\eta}\left[1-F\left(z\right)\right]dz}{D\left[u_z(0,R)+A\alpha_1 S'(R)\right](1-\tau)(1-\eta)^2},
\end{aligned}$$

where in the last two expressions

$$\begin{aligned}
\frac{\partial y_z}{\partial \tau} &= \frac{-\left(1-\eta\right)u_y(y_z,z)}{\beta c_{yy}(y_z,k)-(1-\tau)\left(1-\eta\right)u_{yy}(y_z,z)}<0 \\
\frac{\partial y_z}{\partial \eta} &= \frac{-\left(1-\tau\right)u_y(y_z,z)}{\beta c_{yy}(y_z,k)-(1-\tau)\left(1-\eta\right)u_{yy}(y_z,z)}<0,
\end{aligned}$$

which means the integrands have the opposite sign of u_{yz}.

Even given the sign of u_{yz}, we cannot sign these expressions, in general, and can construct numerical examples with $\partial R/\partial\tau>0$ or $\partial R/\partial\tau<0$. The specification in (3) has $u_{yz}=0$, so that changes in z do not affect the marginal utility of y, although marriage *per se* does when $\varepsilon_0\neq\varepsilon_1$. In this case, all of the derivatives can be signed, as in Proposition 2. Also, as mentioned in the text, when $\alpha_1\to 0$ all results in Proposition 2 again hold.

For completeness we derive $\partial R/\partial i$ for a general $u\left(y,z\right)$ in the monetary economy. Using Kalai bargaining, R satisfies

$$\begin{aligned}
u(0,R)+A\alpha_1 S(R) &= A\alpha_0 S(s)+u(0,s)+ig(y_R,R)-ig(y_s,s) \\
&\quad +\frac{\lambda}{r+\delta}\int_R\left[A\alpha_1 S'(z)-ig_z(y_z,z)+u_z(0,z)\right]\left[1-F(z)\right]dz.
\end{aligned}$$

where

$$g(y,z) \equiv \frac{(1-\theta)\left[u(y,z)-u(0,z)\right]+\theta\beta c(y,k)}{\theta(1-\tau)(1-\eta)+1-\theta},$$

and y_z solves (25). One can derive

$$\frac{\partial R}{\partial i} = \frac{g(y_R,R)-g(y_s,s)+\frac{\lambda}{r+\delta}\int_R \left\{\left[A\alpha_1 u_{yz}-(i+A\alpha_1)g_{yz}\right]\frac{dy_z}{di}-g_z\right\}\left[1-F(z)\right]dz}{D\left[A\alpha_1 S'(R)-ig_z(y_R,R)+u_z(0,R)\right]}.$$

The sign of $\partial R/\partial i$ is ambiguous, in general, but using the specification (3) or letting $\alpha_1 \to 0$, we get Proposition 3.

Appendix B

For the perfect credit baseline model with Kalai bargaining, the effects of (A, α_z) are the same, while:

$$\begin{aligned}
\frac{\partial R}{\partial \theta} &= \frac{A(\alpha_0 S_0-\alpha_1 S_1)}{D\theta\left[\theta(1-\tau)(1-\eta)+1-\theta\right]} \\
\frac{\partial R}{\partial \varepsilon_0} &= \frac{\theta(1-\tau)(1-\eta)A\alpha_0 v(y_0)}{D\left[\theta(1-\tau)(1-\eta)+1-\theta\right]} \\
\frac{\partial R}{\partial \varepsilon_1} &= -\frac{\theta(1-\tau)(1-\eta)A\alpha_1 v(y_1)}{D\left[\theta(1-\tau)(1-\eta)+1-\theta\right]}, \\
\frac{\partial R}{\partial \tau} &= \frac{\theta\beta A(\alpha_1 d_1-\alpha_0 d_0)}{D\left[\theta(1-\tau)(1-\eta)+1-\theta\right]} \\
\frac{\partial R}{\partial \eta} &= \frac{\theta\beta A(\alpha_1 d_1-\alpha_0 d_0)(1-\tau)}{D\left[\theta(1-\tau)(1-\eta)+1-\theta\right](1-\eta)}.
\end{aligned}$$

For the monetary model with Kalai bargaining, again the effects of (A, α_z) are the same, and:

$$\begin{aligned}
\frac{\partial R}{\partial \theta} &= \frac{A(\alpha_0 S_0-\alpha_1 S_1)+i(S_0-S_1)}{D\theta\left[\theta(1-\tau)(1-\eta)+1-\theta\right]} \\
\frac{\partial R}{\partial \varepsilon_0} &= \frac{\left[A\alpha_0\theta(1-\tau)(1-\eta)-i(1-\theta)\right]v(y_0)}{D\left[\theta(1-\tau)(1-\eta)+1-\theta\right]} \\
\frac{\partial R}{\partial \varepsilon_1} &= -\frac{\left[A\alpha_1\theta(1-\tau)(1-\eta)-i(1-\theta)\right]v(y_1)}{D\left[\theta(1-\tau)(1-\eta)+1-\theta\right]} \\
\frac{\partial R}{\partial \tau} &= (1-\eta)\frac{\theta A(\alpha_1 g_1-\alpha_0 g_0)+i\theta(g_1-g_0)}{D\left[\theta(1-\tau)(1-\eta)+1-\theta\right]} \\
\frac{\partial R}{\partial \eta} &= (1-\tau)\frac{\theta A(\alpha_1 g_1-\alpha_0 g_0)+i\theta(g_1-g_0)}{D\left[\theta(1-\tau)(1-\eta)+1-\theta\right]}
\end{aligned}$$

The signs of all these are as stated in Proposition 2.

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Table 1a: Cash Holding per Adult – All Households

	1993	1995	1998	2000	2002	2004	weighted avg
$N = 1$	292.580	297.610	317.030	326.060	312.930	317.780	311.567
	(7.165)	(5.602)	(8.434)	(6.631)	(9.628)	(6.120)	
obs	1220	1274	1131	1446	1757	1837	
$N = 2$	196.530	226.670	202.830	194.260	190.730	199.470	201.711
	(2.830)	(3.060)	(3.455)	(2.833)	(3.343)	(3.101)	
obs	3243	3195	2834	3249	3147	3280	
$N = 3$	146.970	165.970	147.670	142.460	148.220	152.830	150.828
	(3.099)	(3.298)	(3.649)	(3.197)	(3.463)	(3.980)	
obs	1430	1452	1207	1384	1363	1239	
$N = 1/N = 2$	1.489	1.313	1.563	1.678	1.641	1.593	1.545
$N = 1/N = 3$	1.991	1.793	2.147	2.289	2.111	2.079	2.066

Table 1b: Cash Holding per Adult ÷ Total Expend. per Adult – All Households

	1993	1995	1998	2000	2002	2004	weighted avg
$N = 1$	11.330	10.927	11.496	11.391	11.410	9.720	10.978
	(0.298)	(0.210)	(0.276)	(0.242)	(0.543)	(0.193)	
obs	1220	1274	1131	1446	1757	1837	
$N = 2$	8.688	9.790	9.474	8.658	8.763	8.400	8.949
	(0.138)	(0.138)	(0.170)	(0.139)	(0.254)	(0.144)	
obs	3243	3195	2834	3249	3147	3280	
$N = 3$	8.324	8.874	8.675	8.379	8.679	8.301	8.541
	(0.185)	(0.182)	(0.232)	(0.220)	(0.241)	(0.236)	
obs	1430	1452	1207	1384	1363	1239	
$N = 1/N = 2$	1.304	1.116	1.213	1.316	1.302	1.157	1.227
$N = 1/N = 3$	1.361	1.231	1.325	1.360	1.315	1.171	1.285

Table 1c: Cash Holding per Adult ÷ Cash Expend. per Adult – All Households

	1993	1995	1998	2000	2002	2004	weighted avg
$N = 1$	16.729	17.086	19.743	19.105	18.640	18.785	18.395
	(0.398)	(0.340)	(0.440)	(0.381)	(0.574)	(0.456)	
obs	1219	1274	1131	1445	1757	1837	
$N = 2$	13.801	15.109	16.128	15.121	16.122	16.254	15.406
	(0.240)	(0.203)	(0.268)	(0.235)	(0.385)	(0.293)	
obs	3242	3193	2833	3249	3147	3280	
$N = 3$	12.920	13.961	14.508	13.980	14.882	15.357	14.232
	(0.314)	(0.276)	(0.363)	(0.353)	(0.383)	(0.409)	
obs	1427	1451	1207	1384	1363	1239	
$N = 1/N = 2$	1.212	1.131	1.224	1.263	1.156	1.156	1.194
$N = 1/N = 3$	1.295	1.224	1.361	1.367	1.253	1.223	1.293

Notes: Data source – Italian Survey of Household Income and Wealth. $N = j$ for $j = \{1, 2, 3\}$ is the number of adults in a household. Standard errors in parentheses.

Table 2a: Cash Holding per Adult – Households with Bank

	1993	1995	1998	2000	2002	2004	weighted avg
$N = 1$	281.450	294.980	317.760	326.060	272.750	298.200	297.714
	(7.573)	(7.053)	(9.873)	(7.700)	(6.068)	(6.522)	
obs	845	901	874	1112	1343	1420	
$N = 2$	194.700	224.560	202.900	188.690	176.910	181.590	194.551
	(2.971)	(3.352)	(3.782)	(3.036)	(2.918)	(2.896)	
obs	2754	2724	2387	2780	2759	2864	
$N = 3$	149.280	163.250	148.770	139.990	142.380	145.720	148.393
	(3.275)	(3.515)	(3.954)	(3.369)	(3.676)	(4.091)	
obs	1253	1270	1071	1216	1207	1089	
$N = 1/N = 2$	1.446	1.314	1.566	1.728	1.542	1.642	1.530
$N = 1/N = 3$	1.885	1.807	2.136	2.329	1.916	2.046	2.006

Table 2b: Cash Holding per Adult ÷ Total Expend. per Adult – Households with Bank

	1993	1995	1998	2000	2002	2004	weighted avg
$N = 1$	9.757	9.506	10.512	10.335	8.555	8.319	9.360
	(0.280)	(0.230)	(0.293)	(0.257)	(0.214)	(0.195)	
obs	845	901	874	1112	1343	1420	
$N = 2$	8.018	8.988	8.679	7.630	7.242	7.266	7.947
	(0.132)	(0.142)	(0.164)	(0.134)	(0.133)	(0.137)	
obs	2754	2724	2387	2780	2759	2864	
$N = 3$	8.123	8.144	8.064	7.234	7.335	6.983	7.657
	(0.192)	(0.181)	(0.230)	(0.189)	(0.208)	(0.200)	
obs	1253	1270	1071	1216	1207	1089	
$N = 1/N = 2$	1.217	1.058	1.211	1.355	1.181	1.145	1.178
$N = 1/N = 3$	1.201	1.167	1.304	1.429	1.166	1.191	1.222

Table 2c: Cash Holding per Adult ÷ Cash Expend. per Adult – Households with Bank

	1993	1995	1998	2000	2002	2004	weighted avg
$N = 1$	15.012	15.687	19.036	17.980	15.988	16.653	16.716
	(0.410)	(0.361)	(0.502)	(0.416)	(0.344)	(0.359)	
obs	844	901	874	1111	1343	1420	
$N = 2$	13.330	14.342	15.523	14.053	14.225	14.844	14.363
	(0.255)	(0.215)	(0.294)	(0.246)	(0.296)	(0.301)	
obs	2753	2723	2386	2780	2759	2864	
$N = 3$	12.821	13.266	14.025	12.588	13.367	14.238	13.352
	(0.336)	(0.291)	(0.386)	(0.311)	(0.332)	(0.415)	
obs	1250	1269	1071	1216	1207	1089	
$N = 1/N = 2$	1.126	1.094	1.226	1.279	1.124	1.122	1.164
$N = 1/N = 3$	1.171	1.182	1.357	1.428	1.196	1.170	1.252

Notes: Data source – Italian Survey of Household Income and Wealth. $N = j$ for $j = \{1, 2, 3\}$ is the number of adults in a household. Standard errors in parentheses.

Table 3a: Summary Statistics – 2009 FRB Boston Survey

	cash in wallet			total cash holding		
	(1)	(2)	(3)	(4)	(5)	(6)
single	83.151	3.439	9.067	337.760	13.114	42.123
	(12.848)	(0.562)	(2.110)	(127.994)	(4.084)	(16.455)
divorced or separated	63.896	3.020	5.151	190.207	8.858	15.188
	(8.240)	(0.517)	(1.334)	(25.129)	(2.075)	(4.699)
widowed	85.740	2.610	3.284	411.389	11.216	13.636
	(10.527)	(0.405)	(0.453)	(82.674)	(1.940)	(2.167)
nonmarried	76.909	3.195	7.028	318.393	11.434	29.482
	(7.665)	(0.355)	(1.251)	(70.899)	(2.329)	(9.118)
married or common law	64.340	1.802	4.179	284.912	5.633	12.996
	(3.258)	(0.548)	(1.132)	(29.284)	(0.830)	(1.786)
observations	2132	2125	2125	2062	2056	2056

Table 3b: Summary Statistics – 2009 FRB Boston Survey

	cash in wallet $<$ \$1000			total cash holding $<$ \$10000		
	(7)	(8)	(9)	(10)	(11)	(12)
single	83.151	3.439	9.067	359.054	12.842	41.883
	(12.848)	(0.562)	(2.110)	(127.027)	(4.082)	(16.474)
divorced or separated	55.505	2.568	4.713	190.207	8.858	15.188
	(5.175)	(0.374)	(1.299)	(25.129)	(2.075)	(4.699)
widowed	85.740	2.610	3.284	350.067	10.553	12.989
	(10.527)	(0.405)	(0.453)	(56.067)	(1.842)	(2.092)
nonmarried	74.096	3.042	6.884	300.750	11.207	29.278
	(7.409)	(0.336)	(1.250)	(70.028)	(2.328)	(9.131)
married or common law	62.582	1.787	4.127	249.169	5.203	12.139
	(3.091)	(0.549)	(1.133)	(17.202)	(0.791)	(1.715)
observations	2127	2120	2120	2057	2051	2051

Notes:

1. Data source – the 2009 Survey of Consumer Payment Choice by the Federal Reserve Bank of Boston
2. (1) & (7) cash in wallet (in USD); (2) & (8) cash in wallet over household income (in 1k USD); (3) & (9) cash in wallet over household income adjusted for the household size (adults 15 years old or older); (4) & (10) total cash holding (cash in wallet and cash held elsewhere in USD)); (5) & (11) total cash holding divided by household income; (6) & (12) total cash holding divided by household income after adjusting for the household size
3. Nonmarried includes single, divorced, separated and widowed
4. Standard errors are in parentheses.

Table 4a: Summary Statistics – Bank of Canada Survey Questionnaire

	cash in wallet			cash spending		
	(1)	(2)	(3)	(4)	(5)	(6)
single	69.699	1.848	3.621	93.502	2.149	4.455
	(5.501)	(0.132)	(0.382)	(9.029)	(0.153)	(0.601)
divorced or separated	73.007	2.737	3.984	75.627	2.627	3.895
	(6.799)	(0.451)	(0.707)	(4.682)	(0.239)	(0.521)
widowed	95.745	2.996	4.301	104.259	2.982	4.289
	(15.004)	(0.378)	(0.740)	(17.573)	(0.396)	(0.829)
nonmarried	72.513	2.177	3.764	89.291	2.343	4.291
	(4.207)	(0.155)	(0.322)	(6.138)	(0.125)	(0.425)
married or common law	83.229	1.506	3.514	87.746	1.440	3.252
	(11.908)	(0.337)	(1.012)	(6.058)	(0.121)	(0.353)
obs	6183	6183	5038	4995	4995	4108

Table 4b: Summary Statistics – Bank of Canada Survey Questionnaire

	cash in wallet < \$1000			cash spending < \$1000		
	(7)	(8)	(9)	(10)	(11)	(12)
single	65.821	1.768	3.373	86.239	2.050	4.408
	(4.192)	(0.119)	(0.318)	(7.599)	(0.140)	(0.599)
divorced or separated	69.204	2.364	3.446	75.627	2.627	3.895
	(5.827)	(0.262)	(0.448)	(4.682)	(0.239)	(0.521)
widowed	95.745	2.996	4.301	104.259	2.982	4.289
	(15.004)	(0.378)	(0.740)	(17.573)	(0.396)	(0.829)
nonmarried	68.939	2.023	3.454	84.585	2.280	4.260
	(3.377)	(0.111)	(0.249)	(5.267)	(0.119)	(0.424)
married or common law	69.925	1.136	2.455	78.681	1.292	2.873
	(2.810)	(0.066)	(0.171)	(3.671)	(0.095)	(0.277)
obs	6170	6170	5026	4983	4983	4098

Notes:

1. Data source – the 2009 Methods of Payment Survey by the Bank of Canada
2. (1) & (7) cash in wallet (in CAD); (2) & (8) cash in wallet over household income (in 1k CAD); (3) & (9) cash in wallet over household income adjusted for household size (adults 18 years old or older); (4) & (10) weekly cash spending (in CAD); (5) & (11) weekly cash spending over household income; (6) & (12) weekly cash spending over household income adjusted for household size
3. Nonmarried includes single, divorced, separated and widowed
4. Standard errors in parentheses.

Table 5a: Summary Statistics – Bank of Canada Diary Instrument

	cash in wallet			cash spending		
	(1)	(2)	(3)	(4)	(5)	(6)
single	68.978	2.077	3.509	96.129	3.301	5.730
	(4.147)	(0.205)	(0.332)	(9.330)	(0.481)	(0.750)
divorced or separated	119.575	4.022	5.090	147.093	6.024	11.599
	(25.967)	(0.604)	(0.835)	(24.666)	(1.184)	(3.456)
widowed	107.686	3.326	3.830	94.315	3.294	4.455
	(17.353)	(0.485)	(0.708)	(15.381)	(0.566)	(0.963)
nonmarried	85.525	2.694	3.936	109.398	4.018	7.124
	(7.832)	(0.220)	(0.320)	(9.438)	(0.460)	(1.058)
married or common law	83.445	1.412	2.940	111.855	2.026	4.279
	(6.802)	(0.086)	(0.194)	(6.126)	(0.144)	(0.352)
obs	3219	3219	2715	3241	3241	2737

Table 5b: Summary Statistics – Bank of Canada Diary Instrument

	cash in wallet < \$1000			cash spending < \$1000		
	(7)	(8)	(9)	(10)	(11)	(12)
single	68.796	2.072	3.488	83.790	2.657	4.955
	(4.143)	(0.205)	(0.331)	(6.516)	(0.239)	(0.558)
divorced or separated	93.212	3.377	4.574	147.093	6.024	11.599
	(13.693)	(0.412)	(0.708)	(24.666)	(1.184)	(3.456)
widowed	107.686	3.326	3.830	94.315	3.294	4.455
	(17.353)	(0.485)	(0.708)	(15.381)	(0.566)	(0.963)
nonmarried	78.366	2.515	3.789	101.435	3.602	6.612
	(4.922)	(0.183)	(0.291)	(8.513)	(0.376)	(1.013)
married or common law	77.263	1.373	2.825	103.687	1.947	4.129
	(3.454)	(0.079)	(0.166)	(5.287)	(0.142)	(0.350)
obs	3213	3213	2710	3225	3225	2722

Notes:

1. Data source – the 2009 Methods of Payment Survey by the Bank of Canada
2. (1) & (7) cash in wallet (in CAD); (2) & (8) cash in wallet over household income (in 1k CAD); (3) & (9) cash in wallet over household income adjusted for household size (adults 18 years old or older); (4) & (10) weekly cash spending (in CAD); (5) & (11) weekly cash spending over household income; (6) & (12) weekly cash spending over household income adjusted for household size
3. Nonmarried includes single, divorced, separated and widowed
4. Standard errors in parentheses.

Table 6: Regression Results – Bank of Canada Survey Questionnaire

	(1) CW	(2) CS	(3) CW	(4) CS	(5) CW_r	(6) CS_r
constant	2.455***	2.873***	0.349	1.650**	0.260	0.425
	(0.171)	(0.277)	(0.400)	(0.840)	(0.307)	(0.382)
nonmarried	1.000***	1.387***	1.132***	1.106**	0.885***	0.812***
	(0.302)	(0.507)	(0.330)	(0.466)	(0.194)	(0.240)
male			0.727***	1.039**	0.216*	0.302**
			(0.277)	(0.463)	(0.117)	(0.145)
unemployed			1.046***	0.763*	0.756***	0.498***
			(0.367)	(0.461)	(0.260)	(0.180)
less than college			1.007***	1.740***	0.443***	0.723***
			(0.264)	(0.338)	(0.114)	(0.110)
age 26-35			0.293	-0.535	0.442**	0.388
			(0.375)	(0.860)	(0.191)	(0.278)
age 36-45			0.889	-1.144	0.756**	0.190
			(0.634)	(0.861)	(0.307)	(0.251)
age 46-55			0.785**	-0.325	0.711***	0.430
			(0.394)	(1.082)	(0.175)	(0.328)
age 56-65			0.913**	-0.989	0.881***	0.393
			(0.394)	(0.824)	(0.220)	(0.270)
age 66-75			0.660	-1.579*	0.707**	0.177
			(0.524)	(0.830)	(0.319)	(0.354)
household size 2					-0.430	-0.294
					(0.279)	(0.263)
household size 3					-0.432	-0.228
					(0.320)	(0.387)
household size 4					-0.973***	-0.240
					(0.247)	(0.499)
household size 5+					-0.045	0.428
					(0.933)	(1.228)
obs	5026	4098	4500	3707	4500	3707

Notes:
1. Data source – the 2009 Methods of Payment Survey by the Bank of Canada; sample restricted to cash holding or spending less than $1000
2. Nonmarried includes single, divorced, separated and widowed
3. Dependent variable in (1)-(4): cash in wallet (CW) or cash spending (CS) over household income after adjusting for household size
4. Dependent variable in (5)-(6): cash in wallet (CW_r) or cash spending (CS_r) over household income without adjusting for household size
5. Base group: married, female, employed, college and above, age 18-25, household size=1 if dummy included in regression
6. Standard errors in parentheses; p-values: *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Regression Results – Bank of Canada Diary Instrument

	(1) CW	(2) CS	(3) CW	(4) CS	(5) CW_r	(6) CS_r
constant	2.825***	4.129***	1.202**	-0.039	1.343***	0.297
	(0.166)	(0.350)	(0.512)	(0.990)	(0.384)	(0.930)
nonmarried	0.964***	2.483**	0.967***	1.751*	0.752***	1.500***
	(0.335)	(1.072)	(0.366)	(0.968)	(0.205)	(0.563)
male			0.292	0.407	0.168	0.142
			(0.293)	(0.645)	(0.188)	(0.317)
unemployed			1.723***	1.150	1.067***	0.889**
			(0.531)	(0.817)	(0.327)	(0.453)
less than college			1.164***	3.037***	0.624***	1.511***
			(0.224)	(0.527)	(0.142)	(0.219)
age 26-35			-0.733	0.256	-0.045	0.607
			(0.497)	(0.822)	(0.215)	(0.471)
age 36-45			-0.312	1.566	0.299	1.096*
			(0.520)	(1.250)	(0.282)	(0.611)
age 46-55			0.590	1.455	0.694**	1.165*
			(0.617)	(1.504)	(0.306)	(0.681)
age 56-65			0.667	2.417**	0.715**	1.761***
			(0.586)	(1.178)	(0.289)	(0.680)
age 66-75			0.228	2.353**	0.493	1.682**
			(0.681)	(1.193)	(0.368)	(0.751)
household size 2					-1.243***	-0.881
					(0.391)	(0.696)
household size 3					-1.551***	-0.940
					(0.449)	(0.945)
household size 4					-1.803***	-1.975***
					(0.451)	(0.640)
household size 5+					-2.534***	-3.283***
					(0.441)	(0.659)
obs	2710	2722	2429	2438	2429	2438

Notes:
1. Data source – the 2009 Methods of Payment Survey by the Bank of Canada; sample restricted to cash holding or spending less than \$1000
2. Nonmarried includes single, divorced, separated and widowed
3. Dependent variable in (1)-(4): cash in wallet (CW) or cash spending (CS) over household income after adjusting for household size
4. Dependent variable in (5)-(6): cash in wallet (CW_r) or cash spending (CS_r) over household income without adjusting for household size
5. Base group: married, female, employed, college and above, age 18-25, household size=1 if dummy included in regression
6. Standard errors in parentheses; p-values: *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Summary of Macro Data Sources

Data	Source	Time Period	# Countries
Marriages	UNCDB	1950 – 2004	252
Population	UNCDB	1950 – 2004	252
Output	IFS	1948 – 2009	161
CPI	UNCDB	1951 – 2004	156
GDP Deflator	UNCDB	1971 – 2004	214
Unemployment	UNCDB	1969 – 2004	83
Unemployment	IFS	1950 – 2004	73
Unemployment	OECD	1951 – 2003	22
Consumption (Sales) Tax	OECD	1976 – 2011	33
Consumption (Sales) Tax	Mendoza et al.	1965 – 1991	18
Labor Income Tax	Mendoza et al.	1965 – 1992	18
Capital IncomeTax	Mendoza et al.	1965 – 1992	18

Table 9: Panel-data GLS w/o taxes, raw data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_D	0.002 (0.006)	0.006 (0.004)	0.008 (0.005)	0.011** (0.006)				
π_D^2	0.000 (0.000)	-0.000* (0.000)	-0.000*** (0.000)	-0.000*** (0.000)				
π_C					0.000 (0.001)	0.002 (0.002)	0.000 (0.001)	0.001 (0.002)
π_C^2					0.000 (0.000)	-0.000* (0.000)	0.000 (0.000)	0.000 (0.000)
γ		0.135 (0.122)		0.105 (0.114)		0.213 (0.181)		-0.023 (0.169)
u			-0.079*** (0.010)	-0.078*** (0.010)			-0.085*** (0.011)	-0.088*** (0.011)
obs	3315	2282	1072	965	3453	2817	1023	932
NC	152	99	78	71	116	91	74	67

Notes: Definitions of variables: π_D – inflation measured by GDP deflator; π_C – inflation measured by CPI; γ – real output growth rate; u – unemployment rate; and NC – number of countries. Standard errors in parentheses; p-values: *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Panel-data GLS w/ OECD taxes, raw data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_D	0.007 (0.007)	0.036*** (0.007)	0.006 (0.007)	0.042*** (0.008)				
π_D^2	0.001 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)				
π_C					0.031*** (0.004)	0.032*** (0.004)	0.043*** (0.009)	0.043*** (0.009)
π_C^2					-0.000*** (0.000)	-0.000*** (0.000)	-0.000** (0.000)	-0.000* (0.000)
γ		2.469*** (0.297)		3.367*** (0.409)		0.408 (1.308)		0.453 (1.455)
u			-0.036*** (0.013)	-0.034*** (0.012)			-0.035*** (0.012)	-0.035*** (0.012)
τ	-0.089*** (0.011)	-0.062*** (0.009)	-0.050*** (0.011)	-0.049*** (0.010)	-0.080*** (0.010)	-0.055*** (0.009)	-0.045*** (0.010)	-0.045*** (0.010)
obs	320	307	246	245	314	302	245	245
NC	32	31	30	30	32	31	30	30

Notes: See notes for Table 9, and τ – consumption tax rates from the OECD statistics

Table 11: Panel-data GLS w/ Mendoza taxes, raw data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_D	0.032*** (0.010)	0.045** (0.018)	0.038*** (0.012)	0.040* (0.021)				
π_D^2	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)				
π_C					0.009 (0.050)	0.023 (0.050)	0.010 (0.060)	0.018 (0.060)
π_C^2					-0.001 (0.003)	-0.002 (0.003)	-0.002 (0.003)	-0.002 (0.003)
γ		1.389 (1.574)		0.295 (1.794)		6.225*** (2.233)		3.654 (2.789)
u			-0.037 (0.023)	-0.037 (0.023)			-0.067*** (0.023)	-0.060** (0.024)
τ_c	-0.048*** (0.009)	-0.049*** (0.009)	-0.073*** (0.011)	-0.073*** (0.011)	-0.040*** (0.009)	-0.044*** (0.009)	-0.071*** (0.012)	-0.072*** (0.012)
τ_h	-0.058*** (0.009)	-0.056*** (0.009)	-0.056*** (0.009)	-0.055*** (0.010)	-0.080*** (0.008)	-0.075*** (0.008)	-0.067*** (0.010)	-0.065*** (0.010)
τ_k	0.012** (0.006)	0.012** (0.006)	0.007 (0.007)	0.007 (0.007)	0.011** (0.005)	0.015*** (0.006)	0.006 (0.007)	0.009 (0.007)
obs	310	310	241	241	330	330	236	236
NC	18	18	17	17	17	17	16	16

Notes: See notes for Table 9, and τ_c – consumption tax rates, τ_h – labor income tax rates, τ_k – capital income tax rates; all tax rates are from Mendoza et al. (1997)

Table 12: Panel-data GLS, Mendoza sample w/o taxes, raw data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_D	0.048*** (0.007)	0.121*** (0.012)	0.041*** (0.008)	0.107*** (0.014)				
π_D^2	-0.001*** (0.000)	-0.002*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)				
π_C					0.094*** (0.030)	0.119*** (0.030)	0.246*** (0.041)	0.241*** (0.041)
π_C^2					-0.003 (0.002)	-0.003** (0.002)	-0.009*** (0.002)	-0.009*** (0.002)
γ		8.657*** (1.188)		7.705*** (1.353)		9.928*** (1.396)		4.547** (2.245)
u			-0.066*** (0.016)	-0.058*** (0.016)			-0.083*** (0.016)	-0.080*** (0.016)
obs	587	587	483	483	906	890	481	481
NC	18	18	18	18	18	18	18	18

Notes: See notes for Table 9

Table 13: Panel-data GLS w/o taxes, smoothed data (HP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_D	0.076*** (0.015)	0.077*** (0.014)	0.077*** (0.018)	0.111*** (0.020)				
π_D^2	-0.004*** (0.001)	-0.003*** (0.001)	-0.006*** (0.002)	-0.008*** (0.002)				
π_C					0.005 (0.003)	0.009*** (0.003)	0.006 (0.006)	0.022*** (0.007)
π_C^2					0.000 (0.000)	-0.000*** (0.000)	0.000 (0.000)	-0.000*** (0.000)
γ		0.652*** (0.244)		0.668*** (0.308)		1.424*** (0.431)		0.229 (0.437)
u			-0.098*** (0.013)	-0.094*** (0.013)			-0.119*** (0.013)	-0.118*** (0.014)
obs	1726	1405	689	636	2291	1991	707	654
NC	54	45	39	36	50	45	39	36

Notes: See notes for Table 9

Table 14: Panel-data GLS w/ Medoza taxes, smoothed data (HP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_D	0.064** (0.029)	0.075** (0.036)	0.076** (0.038)	0.067 (0.047)				
π_D^2	-0.003* (0.002)	-0.003* (0.002)	-0.004* (0.003)	-0.004 (0.003)				
π_C					0.183*** (0.069)	0.191*** (0.067)	0.234*** (0.079)	0.237*** (0.078)
π_C^2					-0.012*** (0.004)	-0.012*** (0.004)	-0.015*** (0.005)	-0.015*** (0.005)
γ		0.901 (1.798)		-0.681 (2.019)		14.876*** (3.432)		7.879* (4.420)
u			-0.041* (0.021)	-0.041* (0.021)			-0.064*** (0.020)	-0.052** (0.021)
τ_c	-0.044*** (0.008)	-0.045*** (0.008)	-0.069*** (0.010)	-0.068*** (0.010)	-0.046*** (0.009)	-0.053*** (0.009)	-0.080*** (0.011)	-0.081*** (0.011)
τ_h	-0.064*** (0.008)	-0.063*** (0.008)	-0.061*** (0.008)	-0.062*** (0.009)	-0.076*** (0.007)	-0.067*** (0.008)	-0.060*** (0.009)	-0.058*** (0.009)
τ_k	0.012** (0.005)	0.012** (0.005)	0.009 (0.006)	0.008 (0.006)	0.009* (0.005)	0.016*** (0.005)	0.003 (0.006)	0.006 (0.007)
obs	310	310	242	242	330	330	237	237
NC	18	18	17	17	17	17	16	16

Notes: See notes for Table 11

Table 15: Panel-data GLS, Mendoza sample w/o taxes, smoothed data (HP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_D	0.125***	0.177***	0.126***	0.174***				
	(0.020)	(0.021)	(0.022)	(0.025)				
π_D^2	-0.003**	-0.004***	-0.004***	-0.005***				
	(0.001)	(0.001)	(0.002)	(0.002)				
π_C					0.264***	0.224***	0.394***	0.390***
					(0.040)	(0.038)	(0.047)	(0.047)
π_C^2					-0.013***	-0.010***	-0.018***	-0.018***
					(0.003)	(0.002)	(0.003)	(0.003)
γ		7.570***		6.614***		22.684***		2.267
		(1.420)		(1.616)		(2.195)		(3.724)
u			-0.054***	-0.057***			-0.081***	-0.080***
			(0.016)	(0.015)			(0.015)	(0.015)
obs	587	587	489	489	906	890	487	487
NC	18	18	18	18	18	18	18	18

Notes: See notes for Table 9

Table 16: Panel-data GLS, Mendoza sample w/o taxes, smoothed data (5-yr moving avg)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_D	0.139***	0.218***	0.118***	0.200***				
	(0.011)	(0.014)	(0.014)	(0.016)				
π_D^2	-0.005***	-0.005***	-0.005***	-0.005***				
	(0.001)	(0.001)	(0.001)	(0.001)				
π_C					0.145***	0.158***	0.382***	0.364***
					(0.035)	(0.033)	(0.047)	(0.047)
π_C^2					-0.004*	-0.004**	-0.016***	-0.015***
					(0.002)	(0.002)	(0.003)	(0.003)
γ		11.483***		11.236***		19.789***		7.867**
		(1.248)		(1.367)		(1.957)		(3.233)
u			-0.053***	-0.049***			-0.101***	-0.095***
			(0.016)	(0.015)			(0.015)	(0.015)
obs	659	659	561	561	978	962	559	559
NC	18	18	18	18	18	18	18	18

Notes: See notes for Table 9

Table 17: Individual Country - the United States, raw data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_C	0.395***	0.390***	0.670***	0.617***	0.101	0.035	-0.058	-0.086
	(0.099)	(0.094)	(0.155)	(0.151)	(0.118)	(0.127)	(0.105)	(0.113)
π_C^2	-0.017**	-0.014*	-0.036***	-0.029**	-0.005	0.000	0.006	0.008
	(0.008)	(0.008)	(0.011)	(0.011)	(0.007)	(0.008)	(0.006)	(0.007)
γ		9.600**		10.601*		4.974		2.615
		(3.708)		(5.379)		(3.963)		(3.672)
u			0.126	0.127			-0.017	-0.019
			(0.079)	(0.076)			(0.047)	(0.048)
τ_c					0.751***	0.686***	0.675***	0.666***
					(0.174)	(0.180)	(0.176)	(0.179)
τ_h					0.086***	0.094***	0.027	0.042
					(0.027)	(0.027)	(0.043)	(0.049)
τ_k					0.004	0.035	-0.021	0.000
					(0.031)	(0.039)	(0.029)	(0.041)
obs	54	54	36	36	27	27	23	23

Notes: See notes for Table 11

Table 18: Individual Country - the United States, smoothed data (HP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_C	0.729***	0.705***	1.475***	1.368***	-0.171**	-0.164**	-0.052	-0.053
	(0.121)	(0.111)	(0.157)	(0.155)	(0.066)	(0.069)	(0.075)	(0.078)
π_C^2	-0.046***	-0.039***	-0.106***	-0.094***	0.007	0.006	0.000	0.001
	(0.012)	(0.011)	(0.013)	(0.013)	(0.004)	(0.005)	(0.005)	(0.005)
γ		22.831***		20.359**		-1.217		-0.554
		(6.746)		(9.005)		(2.421)		(3.405)
u			0.038	0.071			-0.066**	-0.062
			(0.067)	(0.064)			(0.031)	(0.040)
τ_c					1.226***	1.232***	1.282***	1.273***
					(0.052)	(0.054)	(0.065)	(0.090)
τ_h					0.168***	0.166***	0.194***	0.188***
					(0.009)	(0.010)	(0.020)	(0.040)
τ_k					0.111***	0.107***	0.085***	0.081**
					(0.013)	(0.015)	(0.019)	(0.031)
obs	54	54	36	36	27	27	23	23

Notes: See notes for Table 11

Table 19: Individual Country - Canada, raw data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_C	0.102	0.124	0.772***	0.810***	0.493*	0.275	0.116	0.004
	(0.183)	(0.174)	(0.195)	(0.185)	(0.260)	(0.212)	(0.154)	(0.128)
π_C^2	0.004	0.004	-0.042**	-0.042***	-0.027	-0.011	-0.007	0.003
	(0.124)	(0.015)	(0.015)	(0.014)	(0.017)	(0.014)	(0.010)	(0.009)
γ		13.326**		12.952**		11.446***		9.028***
		(5.389)		(5.943)		(3.048)		(2.859)
u			-0.175*	-0.063			-0.080*	0.04
			(0.086)	(0.096)			(0.043)	(0.052)
τ_c					0.193*	0.093	0.121*	0.073
					(0.104)	(0.085)	(0.058)	(0.049)
τ_h					-0.135***	-0.095***	-0.196***	-0.183***
					(0.024)	(0.022)	(0.024)	(0.020)
τ_k					0.079***	0.101***	0.032	0.085***
					(0.027)	(0.022)	(0.073)	(0.023)
obs	53	53	35	35	27	27	23	23

Notes: See notes for Table 11

Table 20: Individual Country -Canada, smoothed data (HP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_C	0.409	0.328	1.258***	1.280***	0.861***	0.694***	0.732***	0.042
	(0.266)	(0.232)	(0.184)	(0.174)	(0.143)	(0.167)	(0.116)	(0.118)
π_C^2	-0.020	-0.011	-0.082***	-0.083***	-0.054***	-0.040***	-0.049***	0.005
	(0.328)	(0.022)	(0.016)	(0.015)	(0.012)	(0.014)	(0.009)	(0.009)
γ		36.998***		20.781**		5.720*		14.787***
		(9.034)		(9.488)		(3.278)		(2.186)
u			-0.231***	-0.058			-0.133*	0.174***
			(0.066)	(0.101)			(0.065)	(0.056)
τ_c					0.140*	0.162**	0.061	0.138***
					(0.080)	(0.077)	(0.056)	(0.031)
τ_h					-0.148***	-0.122***	-0.141***	-0.179***
					(0.009)	(0.017)	(0.022)	(0.013)
τ_k					0.152***	0.140***	0.057*	0.160***
					(0.012)	(0.013)	(0.032)	(0.022)
obs	53	53	35	35	27	27	23	23

Notes: See notes for Table 11

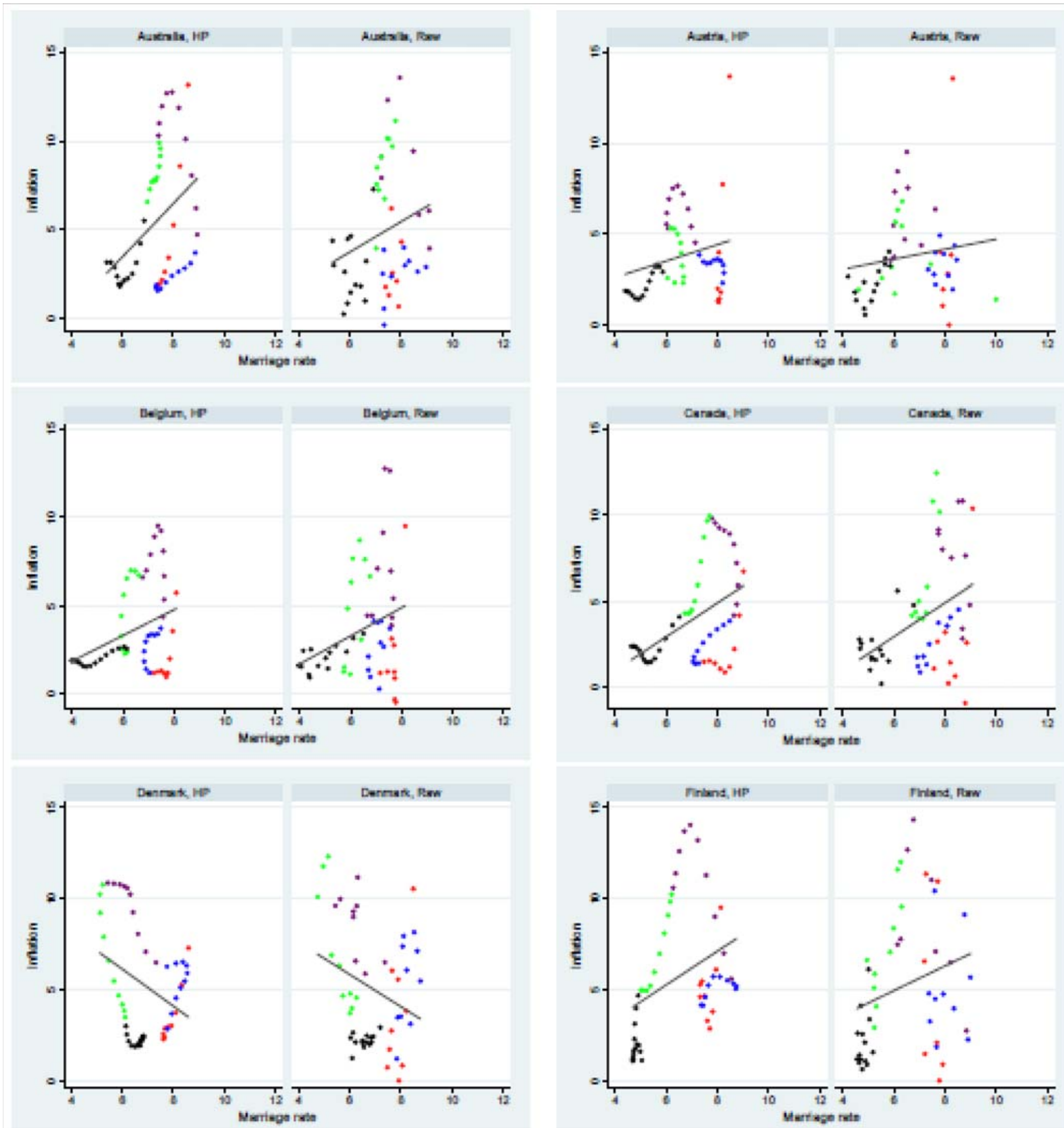

Figure 1: Austria, Australia, Belgium, Canada, Denmak, Finland

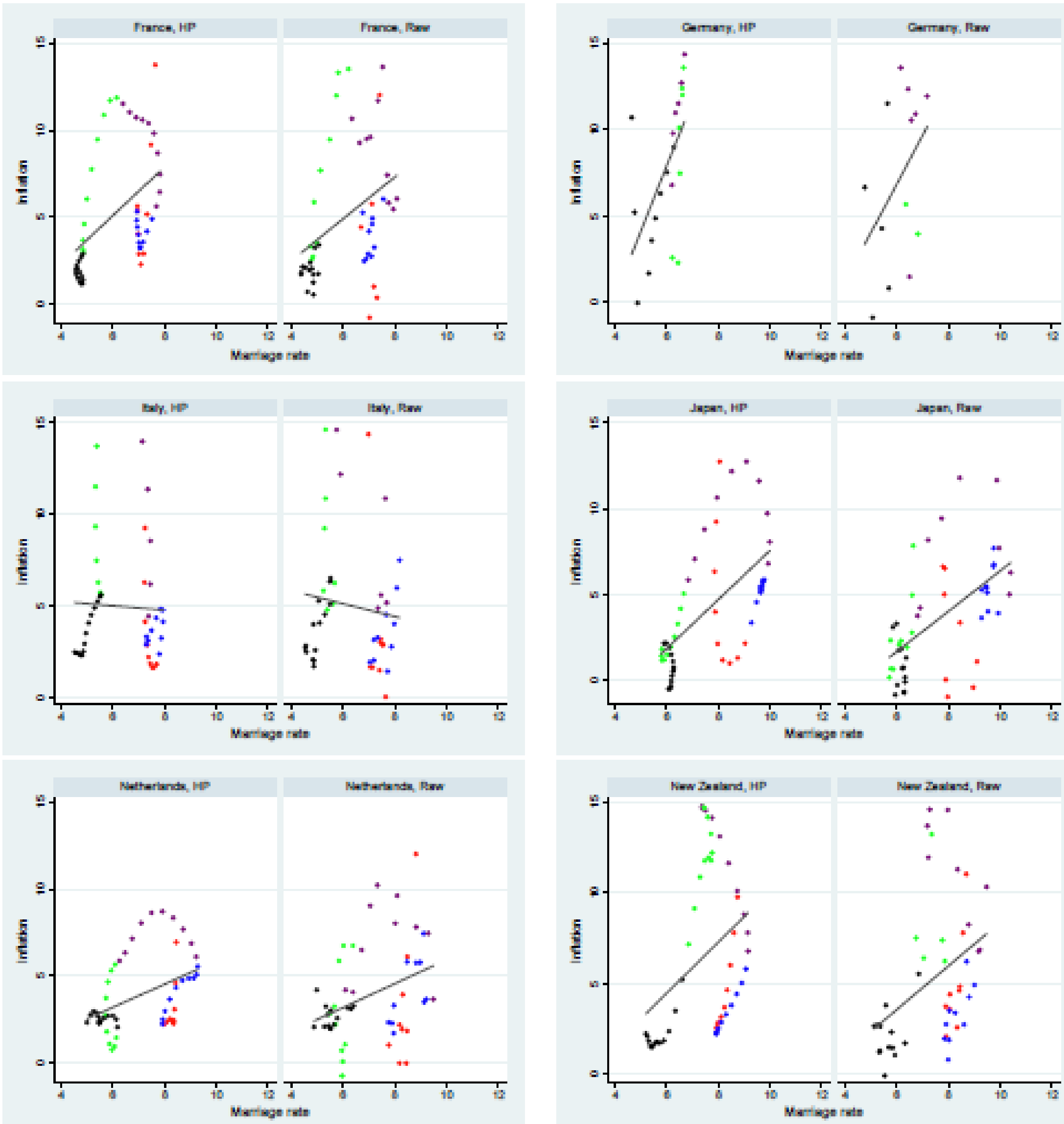

Figure 2: France, Germany, Italy, Japan, Neth., New Zeeland

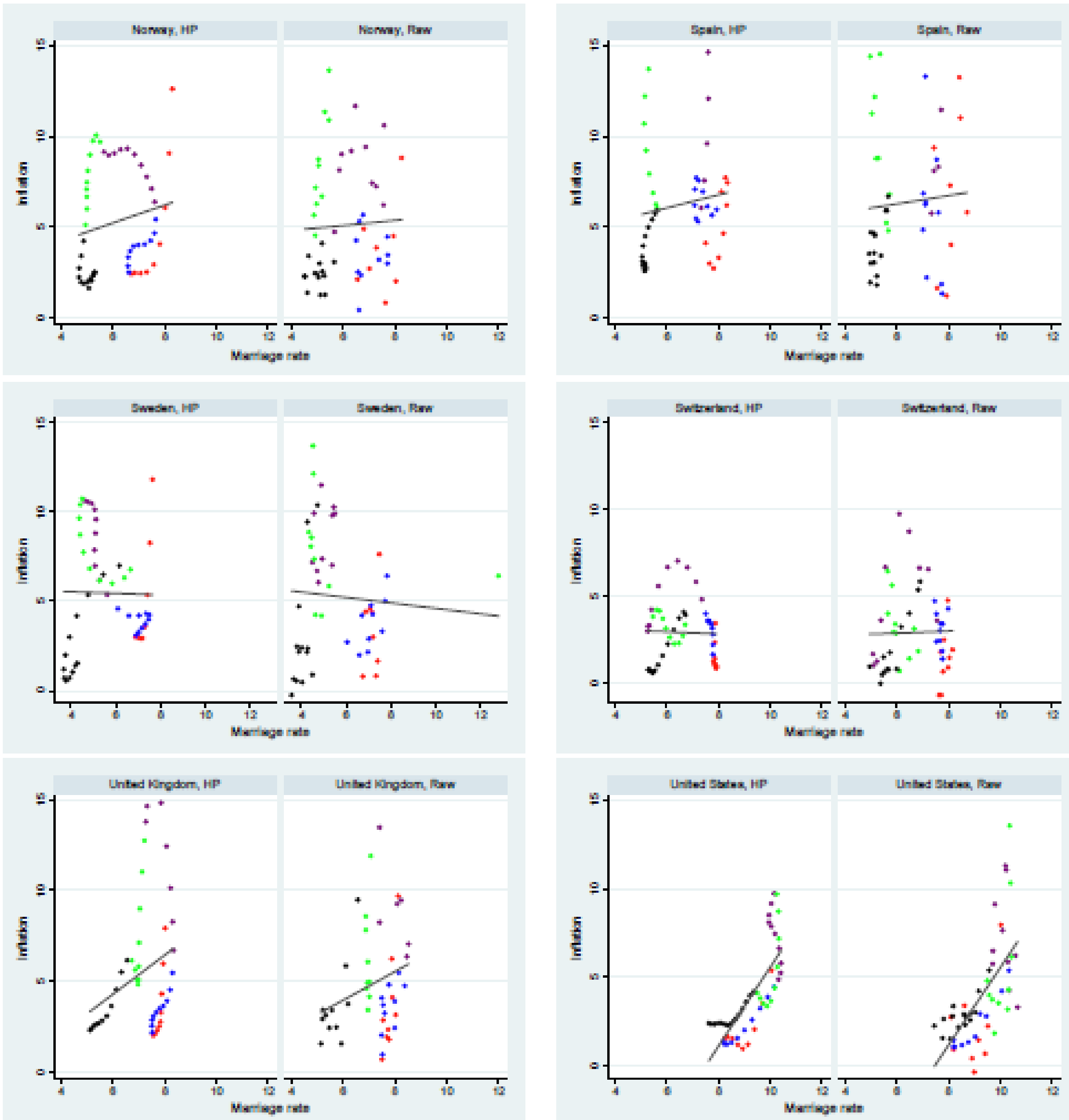

Figure 3: Norway, Spain, Sweden, Swiss., UK, US