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COMPLEMENTARITY AND CUSTOM IN WAGE CONTRACT VIOLATION*

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Abstract

We analyze a model of wage delay in which strategic complementarity arises because each employer's costs of violating its contracts decrease with the arrears in its labor market. The model is estimated on panel data for workers and firms in Russia, facilitating identification through fixed effects for employees, employers, and local labor markets, and instrumental variables based on policy interventions. The estimated reaction function displays strongly positive neighborhood effects, and the estimated feedback loops – worker quits, effort, strikes, and legal penalties – imply that costs of wage delays are attenuated by neighborhood arrears. We also study a nonlinear case with two stable equilibria: a punctual payment and a late payment equilibrium. The estimates imply that the theoretical conditions for multiple equilibria under symmetric labor market competition are satisfied in our data.

JEL Classifications: A12, B52, J30, K42, L14, O17, P31, P37

Keywords: contract violation, wage arrears, social custom, strategic complementarity, neighborhood effect, social interactions, multiple equilibria, network externality, transition, Russia

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"Quid leges sine moribus vanae proficiunt"
(Of what use are laws empty of customs?)
HORACE, *Odes*, 3.24

1. Introduction

The wage contract is a fundamental economic institution whose essential elements are agreements concerning the nature of the work, the wage to be paid, and the time of payment. Economists typically assume that employers abide by their side of the contract, paying their employees reliably and on time, an assumption that appears to conform with the usual practice of firms in developed market economies.[1] But this assumption may not always be warranted, and it is clearly violated in post-Soviet Russia, where failures to pay wages on time have become substantial and persistent in many parts of the country. At the peak of wage arrears in late 1998, 62 percent of Russian workers reported overdue wages averaging 4.8 monthly salaries per affected worker, with rates much higher in some areas and much lower in others.[2]

Why do most employers regularly honor their wage contracts, but in some cases breach them on a large scale? These extreme outcomes are difficult to explain by any single, smoothly varying factor such as the effectiveness of legal enforcement. The legal system is presumably part of the answer, but as Horace suggested in 23 B.C., much more is involved. In this paper, we hypothesize that the practices of honoring or breaching wage contracts are characterized by increasing returns resulting from interactions within local labor markets. Among firms, strategic complementarities arise because a firm's costs of violating its contracts decrease in the extent to which other firms, particularly those competing in the same labor market, violate their contracts. Among workers, changing opportunities and social interactions affect the magnitude of response to nonpayment, such that the responsiveness decreases in the magnitude of wage contract violations in the local area. Specifically, we argue that workers may be less likely to quit, strike, or shirk in response to their own arrears if violations are common in their neighborhood.

[1] In fact, there is no systematic data collection about breaches of the wage contract in most economies (perhaps because they are rare), although anecdotal evidence suggests they do occur. The total number of wage and hour rule violations in the US during fiscal year 2003 (including some failures to pay wages on time) is reported by Department of Labor (2006), with 31,123 complaints involving 342,358 employees and $213mln in back pay.

[2] We discuss the definitions and data sources in the next section. Substantial wage arrears have also appeared in some other formerly socialist economies (Croatia, Kazakhstan, Moldova, Ukraine), but not in other economies of Eastern Europe and the former Soviet Union.

Furthermore, the legal system itself is endogenous in our analysis because the effectiveness of contract enforcement within a jurisdiction is negatively related to the prevalence of violations for several possible reasons: congestion in the legal system, reduced probability that workers file complaints, and changing norms among enforcement agents such as judges and prosecutors. These quit, strike, effort, and legal mechanisms constitute feedback mechanisms affecting the firm's costs of alternative payment strategies.

We present this argument in the form of a model of the managerial choice of the amount of overdue wages owed to an employee. Under some conditions, the model generates multiple equilibria, and we study a symmetric game resulting in three: a stable equilibrium in which wage contracts are honored so that overdue wages are negligible, an unstable equilibrium with an intermediate level of wage contract violation, and a stable equilibrium with many violations and high arrears. The stable equilibria can be interpreted as reflecting institutional lock-in, implying that massive shocks or coordination may be required to reduce the number of violations from a high level, and the unstable equilibrium represents a critical mass. The model explains not only why arrears tend to persist once they have become pervasive, but also why they tend to disappear quickly when they are not widely established. In this sense, the practice of paying wages on time can be regarded as a social custom as well as an institution.[3]

An interesting property of well-established customs, such as paying workers on time, is that they tend to be unquestioned, taken for granted. Most employers do not treat the decision of delaying wage payments as a choice variable, and most employees do not wonder every payday whether they will in fact receive their contractual wages. In developed market economies, these possibilities are generally not even considered, regardless of their importance – and receiving reliable wage payments is perhaps the most important economic custom for many people. The premise of this paper is that much can be learned about such customs by analyzing a case where they break down massively, as occurred in Russia in the 1990s. The rise of overdue wages led to

[3] Akerlof (1980, p. 749) defines a social custom as existing when the utility of an action to an agent "depends on the beliefs or actions of other members of the community." The implied dependence is positive and thus very similar to the definition of strategic complementarity in Bulow et al. (1985) and Milgrom and Roberts (1990). Our interpretation of the wage payment practice as an institution in the sense of a set of equilibrium strategies in a game is consistent with Aoki (2001). Closely related is the notion of convention, defined by Young (1993, p. 57) as "a pattern of behavior that is customary, expected, and self-enforcing."

public outcry, with opinion polls ranking the issue as one of the top economic problems facing the country, but paradoxically, wage payments for many workers remained unreliable for years.[4] Besides the size and persistence of this breakdown in ordinary wage contracts, our motivation for focusing on Russia is the fruitful testing ground it offers through the geographic variation within the country, the availability of linked employer-employee panel data, and the presence of policy interventions providing instrumental variables for estimation.

Our empirical analysis of the Russian data has several components. First, we estimate a linear reaction function for wage contract violations, exploiting the unique features of our linked panel data that permit us to control both for correlated observables and for unobservable effects at the levels of the individual, the firm, and the local labor market (defined narrowly as the district or *rayon*). To identify the endogenous interactions within local labor markets, we employ instrumental variables based on exogenous policy interventions affecting a subset of employers, in the spirit of Moffitt's (2001) suggestion for identification of social interactions. Second, we directly estimate four feedback loops—involving quits, changes in effort, strikes, and legal penalties—that contribute to the strategic complementarity. We also examine the maintained hypothesis that there is no compensating adjustment of wage rates. The final empirical analysis involves estimation of a nonlinear form of the reaction function. Assuming symmetric competition in the local labor market and Nash behavior by managers, we calculate the three equilibria implied by our empirical estimates.

The paper contributes to several distinct branches of economic research. To start with, our analysis is closely related to interactions-based models, which have been applied to many issues involving social dynamics, network externalities, strategic complementarities, informational cascades, and coordination problems.[5] In these models, interactions typically

[4] Wage arrears are sometimes ranked as the single biggest national problem. See Javeline (2003) for a discussion of these polls, including the result that, despite the large decline and volatility of real wages through much of this period, Russians frequently rank wage arrears as a bigger problem than low wages. Yet wage arrears in most cases do not imply that workers are frequently or never not paid, but only occasionally (as we discuss in Section 2, below). Russian workers evidently abhor the uncertainty about if and when they will be paid, and they value the reliability of regular wages more than the actual wage level.

[5] Among the issues are peer effects (Evans et al., 1992; Sacerdote, 2001); crime (Sah, 1991; Glaeser et al., 1996); labor supply (Woittiez and Kapteyn, 1998; Weinberg et al., 2004; Grodner and Kniesner, 2006); neighborhood effects (Katz et al., 2001; Kling et al., 2005); technology adoption (David, 1985; Katz and Shapiro, 1986; Arthur, 1989); and aggregate growth and fluctuations (Diamond, 1982; Cooper and John, 1988; Murphy et al., 1989; Azariadis and Drazen, 1990; Durlauf, 1991). On informational cascades, see Bikhchandi et al. (1992), and on conformity see Bernheim (1994). Social interactions were first formalized by Becker (1974); Blume and Durlauf (2001) and Glaeser and Scheinkman (2002) provide surveys of the large literature.

promote convergent practices, and, depending on parameters, may generate multiple equilibria. Empirical analyses of the phenomena, however, face daunting identification problems (e.g., Manski, 1993; Brock and Durlauf, 2001; Moffitt, 2001).

In our analysis of wage contract violations, the interactions occur on multiple levels: the choices by firms whether and how much to breach their contracts and the responses by workers and the legal enforcement regime to the contract breaches are all determined endogenously within local labor markets. Our case offers unusual opportunities for identifying the interaction effects econometrically, and we exploit the availability of detailed observable characteristics, fixed effects, and instrumental variables. Unlike most studies of interactions-based models, we directly measure several mechanisms that may support strategic complementarities in the contract violation practice.

The possibility of important interaction effects has received little attention in previous research on effective contract enforcement, frequently argued to be one of the institutional foundations of successful economies.[6] Yet the prevalent terms "rule of law," "business environment," and "investment climate" imply the existence of an overall culture in which individual actions are influenced by the choices made by other actors. Similarly, a major theme in the literature on the transition from socialism is the importance of new market-supporting institutions, including those related to contract enforcement (Murrell, 1992; Dewatripont and Roland, 1996; Greif and Kandel, 1995). But there has been little empirical analysis of these institutions, and no attention either to the role of interactions or to mechanisms that not only fail to support markets but actually serve to undermine them.[7]

Previous studies of Russian wage delays have established some of the empirical regularities that motivate our analysis (e.g., Gimpelson, 1998; Lehmann et al., 1999; Desai and Idson, 2000). We depart from this literature in our analytical approach, our use of linked employer-employee data (rather than just individual information from household surveys), and our interpretation of arrears as a breach of contract rather than a flexible wage adjustment (as in

[6] See North (1990) and Hadfield (2004). Historical case studies of contract enforcement institutions include Greif, (1993); Greif, Milgrom, and Weingast (1994); and Milgrom, North, and Weingast (1990). The role of custom in a different aspect of contracts – the sharing rule in tenancy contracts – is studied by Young and Burke (2001).

[7] More similar to our analysis are studies of multiple equilibria in the unofficial economy (e.g., Johnson et al., 1997) and in corruption (e.g., Bardhan, 1997).

Layard and Richter, 1995). Studying arrears from 1994 to 1996, Earle and Sabirianova (2002) report substantial variation both between and within firms (implying linked data should be used for analysis) and high levels even in well-performing firms (whether measured by profitability, productivity, hiring rate, output growth, employment growth, cash flow, or liquidity ratio). These results are only descriptive, however, while in this paper we develop and estimate an explicit model. Our model produces strategic complementarity and possible multiplicity of equilibria in wage delays, and we test its implications using new panel data from firm surveys we have organized and linked to employee information for a much longer period.[8] Unlike previous descriptive studies, our econometric tests seek to establish causality and therefore require attention to severe identification problems (endogeneity and correlated unobservables), which we take into account in estimating the reaction function. We also estimate the hypothesized feedback loops and the equilibrium outcomes implied by the model. Thus, our paper brings together and contributes to research on the specifics of the Russian economy and the broader literatures on interactions, institutions, contract enforcement, and transition.

The next section introduces our data. Section 3 presents a simple model to motivate our analysis of firm interactions and feedback loops. Section 4 describes our identification strategy and presents estimation results for the linear reaction function. Section 5 contains estimates of feedback loops through worker turnover, effort, strikes, legal remedies, and wages. The possibility of a nonlinear reaction function is developed theoretically and estimated empirically in Section 6. Section 7 concludes with a brief summary and discussion of welfare implications.

2. Data

2.1. Data Sources

Our model analyzes the determination of wage arrears in a particular employment relationship for a firm and a worker. The data required to test the model include detailed information on both sides of the relationship, which we obtain from several sources. The source

[8] Our firm data cover 1991-1999 and our worker data cover 1994-2000. After 2000, the firm identification information is no longer available in the worker data, nor is the location of observations in the narrow geographic units (districts) of our analysis. Subsequent household data show that much of the decline in aggregate arrears had occurred by our last observation; in late 2003, 26 percent of workers still reported arrears, down from about 30 percent in late 2000. Arrears have continued to attract public attention; see RFE-RL (2004), for instance.

of the worker data consists of the 1994-2000 waves of the Russian Longitudinal Monitoring Survey (RLMS), a household panel based on the first national probability sample drawn in Russia.[9] We have extended these data by using information provided by most working respondents on their employers (but not included in the published data set) to identify individual firms and the industries in which they operate.[10] This allows us to control for constant firm heterogeneity and time-varying industry and to construct reliable measures of job mobility. We can distinguish job quits reliably from intrafirm mobility, and we can measure job tenure accurately. These are critical variables in our theoretical model.

A second major data source is a detailed survey of agricultural and industrial employers, which collected information on wage arrears, quits, strikes, legal penalties, and other variables for the years 1991-1999. Our sampling frame was every identifiable employer of RLMS respondents, thus constituting a national probability sample of employers in industry and agriculture, with selection probability proportional to employment size.[11] Unlike most surveys of firms, our procedure did not replace nonrespondents, and great efforts were expended to include every firm. As a result of this procedure, the response rate is high: 64 percent among industrial firms (522 firms) and 73 percent among agricultural firms (75 firms). Missing values reduce the sample to 560 (486 industrial and 74 agricultural firms). We also add regional data from the Russian Labor Ministry Inspection Service on Labor Code violations and case outcomes, from which we construct regional measures of the effectiveness of legal enforcement.

2.2. Measuring Wage Contract Violations

Our measure of wage contract violations is the stock of overdue wage debt owed by a particular employer to a particular employee. Following the standard practice in Russia—among both workers and firms—we express these arrears in terms of the number of monthly wages the

[9] See Swafford et al. (1997). The RLMS data we use are results of longitudinal surveys of about 10,000 individuals in late fall of 1994, 1995, 1996, 1998, and 2000. Information on wage arrears is unavailable before 1994, and availability of links to firms and precise geographic location restrict our attention in this paper to 1994-2000.

[10] Some ambiguities of classification prevented us from coding industry for all jobs, but we were able to code the following number of cases: 4828 respondents of 4896 employed in 1994, 4528 of 4575 employed in 1995, 4346 of 4383 employed in 1996, 4215 of 4250 employed in 1998, and 4449 of 4508 employed in 2000.

[11] This statement is conditional on the RLMS sampling, which involves a two-stage geographic stratification procedure followed by random drawing of households (residences). Again, see Swafford et al. (1997) for details.

firm owes the worker.[12] The RLMS asks this question directly, and the answers provide the measure of individual wage arrears (denoted ω) that we analyze.

There are no good measures of arrears prior to 1994, but from anecdotal reports it is clear that they were negligible in the Russian economy before 1993.[13] As shown in Table 1, however, the unconditional mean of ω already exceeded one monthly wage in 1994, and it rose in 1996 and again in 1998 before falling in 2000; the distribution of the variable shows pronounced rightward shifts in 1996 and 1998. The mean level of ω is slightly lower in the public sector, which is defined on the basis of industries dependent on the state (federal, regional, and municipal) budgets in Russia: defense industries, municipal utilities, health services, social work, education, culture and art, science, public administration, military, and public order and safety. However, it is significantly higher in the defense sector, comprising defense manufacturing and the military, categories we distinguish because they are paid entirely from the federal budget and thus should be independent of local decision-making.

The proportion of workers with two or more months of arrears was already about 25 percent in 1994, and it had increased to nearly 44 percent by 1996 and 50 percent by late 1998. Conditional on having arrears, the expected magnitude rose from 3.3 to more than 4.8 months. While this debt represents a large fraction of a worker's income, note that the increase of about 1.5 monthly wages over this 2-year period implies the loss of only about 0.75 monthly wages each year, or about 6 percent of annual income. Moreover, workers could hope to receive at least some of their back wages in the future, and indeed the conditional mean fell to 4.2 monthly wages in 2000 and the fraction with arrears fell from 62 to 27 percent. Workers' negative reactions to wage arrears appear to result more from the uncertainty about when and if they will be paid than from the implied reduction in real wages.

In our empirical tests of the model's hypotheses, we construct a measure of local arrears (Ω) from the RLMS by aggregating ω up to the district (*rayon*) level, each time omitting the particular firm for which the individual worker is employed. While analyses of Russian regions

[12] Wages are paid monthly in Russia, as in most European countries, and firm managers usually refer to the number of monthly wage bills when discussing arrears.
[13] Official data on wage arrears in Russia are incomplete and inconsistent in coverage, but they show generally similar patterns over time as the RLMS data. See, for instance, Goskomstat (1999).

are frequently conducted at the level of the *oblast*, we feel that the district much better reflects the scope of the local labor market.[14] Table 1 illustrates the substantial variation across selected districts, some with trivial levels of arrears and others with up to 12 monthly wages per employee.

2.3. Sample Characteristics

Table 2 displays means and standard deviations for worker and job characteristics in the RLMS sample. The sample is restricted to employees at their primary job. 36.7 percent are employed in the public sector and 5.3 percent in the defense sector. 10.9 percent of pensioners report not receiving their pension in the previous month, another type of arrears due to federal government decision-making that our identification strategy exploits. Definitions of most individual attributes (such as gender, age, job tenure, years of schooling, employee ownership, occupation, and industry) are straightforward. The hourly wage rate is computed as the ratio of the contractual wage to the usual hours of work in the previous month.[15] Family income includes income (monetary and in-kind) received during the past month from all jobs, as well as retirement and unemployment benefits of all members of the household. All income measures are calculated in constant December 2000 prices using the monthly Consumer Price Index (CPI).

Previous studies have found that wage arrears are more common among men, negatively associated with schooling, and positively related to age and job tenure; these may reflect skill specificities, mobility costs, and outside opportunities.[16] Workers with arrears are more likely to be small shareholders and to have lower wages and family incomes. Craft workers, operators, and assemblers tend to experience the highest rates, while managers have the lowest—although the rate is high even for this occupation. Wage arrears are found in firms with a high level of financial and operating performance, as well as those performing poorly. Finally, variation across industries is large, with higher incidence and magnitude in agriculture, defense and heavy

[14] The Russian Federation has 89 *oblasts* and other "subjects," some of them larger than Texas. The next lower administrative level is the *rayon*, of which there are 22 per *oblast* on average, thus roughly equivalent to a U.S. county. Our data contain 52 *rayons*, thus 52 different values of Ω in each year of the RLMS sample.

[15] Wage arrears produce high volatility in the measured wage. In a given survey month, the reported wage is frequently zero (as high as 30 percent of responses by workers); it will be lower than the contractual wage when new wage debts are incurred and higher than the contractual wage when they are paid off. To measure the contractual wage, we added questions to the RLMS in 1998 and 2000, and for the earlier years we have followed Earle and Sabirianova (2002), imputing it as the ratio of the total wage debt to the number of monthly wages owed (ω).

[16] See Lehmann, et al. (1999), Desai and Idson (2000), and Earle and Sabirianova (2002) for descriptions of the empirical patterns. We do not report them here, but they also hold in our data.

industrial sectors, as well as in services financed through the state budget (education and health). In a new and rapidly developing sector like banking and finance, however, arrears are very small.

Summary statistics for the firm sample appear in Table 3. Compared with Tables 1 and 2, mean ω and Ω are somewhat smaller in the firm data (although variation over time in these variables is quite similar across sources). There are two reasons for the difference: the time span begins earlier in the firm survey (as early as 1991 for some firms), and the firm survey excludes most of the public sector. The latter consideration prevents us from using the firm data to follow the instrumental variables strategy in Section 4, and the firm survey data are used only in the estimation of feedback loops associated with costs of arrears.[17]

Table 3 also shows control variables in the firm sample: union density, fringe benefits, training costs, industry, local type, and legal environment. These variables, as well as the quit rate and incidence of strikes and legal penalties, are introduced in Section 5.1 below.

3. A Model of Wage Arrears

This section presents a stylized model of managerial decisions about wage delays that focuses attention on interactions within local labor markets. The model is also useful as a framework for considering several types of feedback loops that may support the use or nonuse of the late payment practice, for laying out critical assumptions in the analysis, and for suggesting important factors to control for in the empirical work. Although arrears decisions have an important dynamic component, including the expectations of managers and workers concerning each other's behavior and the evolution of exogenous determinants, our static model captures the essential features of arrears we would like to describe.[18]

The main result of the model is a general reaction (or best-response) function that relates an individual firm's arrears behavior to the prevalence of arrears in the firm's local labor market. This reaction function is assumed to apply only to firms in the nonpublic sector of the economy, as public sector arrears are affected by government decisions – assumptions that we use in our identification strategy to empirically estimate the reaction function in Section 4.

[17] We have estimated the reaction function using the firm survey data with firm fixed effects and time-varying firm characteristics, with results qualitatively similar to those we report below; they are available on request.
[18] In addition, it is problematic to estimate a dynamic model because of the shortness and low frequency of the time series available.

3.1. Returns and Costs to Wage Arrears

Consider a nonpublic firm whose manager chooses the level of back wages ω owed a particular employee in a particular time period to maximize π, which may represent either the firm's profit or the manager's private net benefits. ω is essentially an involuntary loan from the worker to the firm, and we assume it earns the manager a gross per-period return of $R(\omega, X)$, with marginal return $R_\omega(X) = r(X)$ assumed to be constant in ω but varying according to some characteristics of the firm, X (assumed to be scaled so that $r_x > 0$). The relevant characteristics may include the liquidity needs of the firm, the effective interest rate that it faces in borrowing from other sources, and the ability of the manager to appropriate the returns by diverting the funds to projects earning private benefits. In Russia until August 1998, for example, poorly monitored managers could invest spare funds in short-term government treasury bills (GKOs), earning rates up to 150 percent. In such situations, wage arrears are likely to be more attractive to managers who can relatively easily channel the extra cash flow to their own purposes.

While it is not difficult to appreciate the potential returns that the firm might obtain from breaching its wage contracts, there are also costs of not fulfilling these obligations. The potential costs include increased worker turnover, lowered effort, and higher probabilities of strikes and legal penalties.[19] In each of these cases, we argue that the associated costs are positive functions of ω, but that the marginal cost is attenuated by the magnitude of arrears in the rest of the firm's local labor market, Ω. The rationale for each type of cost is fairly straightforward, and we provide evidence on the form of the costs in the empirical analysis below.

A first type of cost arises because delaying wages may increase quits, if the worker responds by moving to another job or exiting the labor force altogether. We assume that quits impose costs Q of replacement, associated with the need for hiring, screening, and training (e.g., Oi, 1962; Stiglitz, 1974). The quit decision is not modeled explicitly, but we assume the manager knows the probability of the worker quitting as a function of ω and Ω; and we hypothesize a negative impact of Ω on the worker's quit response to arrears and thus on the firm's marginal cost of arrears. Higher Ω reduces the quit responsiveness because it reduces the

[19] If π is private benefit rather than profit, these costs to the firm reduce the rents that the manager can take out of the firm, implying that they should matter to the manager as well.

attractiveness of mobility to other firms, and it may also increase the worker's acceptance of the unreliability of wage payments. Because workers differ in their mobility costs and outside opportunities, we permit the quit function to vary with a set of characteristics such as current compensation, firm-specificity of skills, mobility costs, and local labor market conditions included in the Z^Q vector, so that $Q = Q(\omega, \Omega, Z^Q)$, with $Q_\omega > 0$ and $Q_{\omega\Omega} < 0$.[20]

Wage delays may also affect productivity. If morale declines and if effort is not perfectly observable, then workers may be more likely to shirk and, where they have some discretion over hours of work, to reduce their hours. We summarize these agency issues as "effort costs," E, and assume that the manager expects that higher arrears may reduce productivity through mechanisms similar to those in the efficiency wage literature (Akerlof, 1982; Shapiro and Stiglitz, 1984). Such costs are likely to vary with worker characteristics, Z^E, including the importance of morale for productivity, the difficulty of monitoring, and the degree of independence the worker has in decision-making. We hypothesize that the negative effort effect is attenuated by wage arrears in the rest of the firm's local labor market, Ω, as the worker's decisions are influenced by outside alternatives (for instance, if caught shirking and fired) and by perceptions of the practice's fairness or legitimacy (which are influenced by social interactions). The effort costs may thus be written as $E(\omega, \Omega, Z^E)$, with the properties $E_\omega > 0$ and $E_{\omega\Omega} < 0$.

Another type of cost results if arrears increase strikes and other forms of protest behavior, resulting in costs summarized by $S(\omega, \Omega, Z^S)$. Again, we assume a positive relationship that is attenuated by arrears in the local labor market, such that $S_\omega > 0$ and $S_{\omega\Omega} < 0$. The argument is that workers view arrears in the context of what is "normal" in their environment, and they are less likely to protest their own arrears when their friends and neighbors are also being paid late. The probability of such behavior is likely to be a function of other characteristics of the firm and worker, particularly the extent of unionization, included in a set of exogenous variables Z^S.[21]

[20] Firms attempting to reduce employment may welcome quits and use wage arrears to increase them. But the relevant complementarity condition $Q_{\omega\Omega} < 0$ remains the same, as this implies ω increasing in Ω.

[21] Our choice of these variables and our analysis of Russian strike behavior are motivated by the broader literature on strikes (e.g., Kennan, 1986). Our hypothesis that strike behavior in response to arrears is partially a function of arrears in the local labor market is related to the standard notion that employees may gauge their wage demands to wages in a reference firm or sector, as in "pattern bargaining" (Levinson, 1960; Lee and Pesaran, 1993).

A final type of cost arises because wage arrears are violations of legal contracts, resulting in possible legal penalties and associated costs $L(\omega, \Omega, Z^L)$.[22] Again, we hypothesize that the probability of legal costs is positively related to the level of arrears in the firm, but that the marginal effect is lower in jurisdictions with higher arrears, such that $L_\omega > 0$ and $L_{\omega\Omega} < 0$. One motivation for this hypothesis is that the legal system in a jurisdiction may become congested with arrears cases, reducing the probability of punishment, similar to Sah's (1991) analysis of the probability of punishment falling with the crime rate. Furthermore, in a high arrears environment, breaches of the wage contract may be perceived as normal and legitimate, and law enforcement officials may therefore be less likely to press cases and assess severe penalties against infractions; workers may also be more pessimistic about the chances of resolving the problem through legal channels. In the analysis of legal penalties and wage arrears, it is also important to take into account regional variation in the effectiveness of the legal system stemming from factors other than the congestion and lawsuit filing effects, Z^L.

To summarize, managers face four costs of wage arrears: E, Q, S, and L, each of which is a function of ω, Ω, and some shift variables, the vector Z. Although the costs are not directly observable, some proxies for the underlying behavior can be measured in our empirical work. For convenience in the exposition of the rest of the model, we consider the sum of the four costs $C(\omega, \Omega, Z) = E(\omega, \Omega, Z^E) + Q(\omega, \Omega, Z^Q) + S(\omega, \Omega, Z^S) + L(\omega, \Omega, Z^L)$, where $Z = (Z^E, Z^Q, Z^S, Z^L)$ is a vector of other factors such as worker compensation and fringe benefits, skill specificity, search costs, difficulty of monitoring, strength of worker organization, functioning of the legal system, and characteristics of the local labor market. The assumption that $C_{\omega\Omega} < 0$, so that the marginal cost is declining with local labor market arrears, is the crucial mixed partial derivative condition for strategic complementarities to emerge (e.g., Milgrom and Roberts, 1990). In our empirical analysis in Section 5 below, we test this assumption directly for each component of costs: the negative effects of a worker's arrears on her morale and work hours should decline in absolute value with the arrears level in the local labor market, and the positive effects of arrears on quits, strikes, and legal penalties should be attenuated by local labor market arrears.

[22] The Russian Labor Code explicitly requires on-time payment of wages, and firms may be called to account by the civil courts (when workers file a lawsuit) or the Ministry of Labor's Inspection Service. The latter has been known to fine managers as well as firms, and, more rarely, to order managerial dismissal.

3.2. The Reaction Function: $\varpi = f(\Omega, X, Z)$

The manager chooses ω to maximize the expected net return π:

$$\max_{\{\omega\}} \pi = R(\omega, X) - C(\omega, \Omega, Z), \tag{1}$$

where ω is the amount of back wages owed to the worker and Ω is the average amount of wage arrears in the local labor market outside the firm.

The first and second order conditions for the manager's problem (1) are as follows:

$$\frac{\partial \pi}{\partial \omega} = r(X) - C_{\omega}(\omega, \Omega, Z) = 0 \tag{2}$$

$$\frac{\partial^2 \pi}{\partial \omega^2} = -C_{\omega\omega} < 0, \tag{3}$$

implying the following optimality condition:

$$r(X) = C_{\omega}(\varpi, \Omega, Z). \tag{4}$$

The reaction function, the best response to other firms' choices, can be derived as

$$\varpi = f(\Omega, X, Z). \tag{5}$$

Total differentiation of the first order condition yields

$$r_X\, dX - C_{\omega\omega} d\omega - C_{\omega\Omega} d\Omega - C_{\omega Z}\, dZ = 0. \tag{6}$$

Making use of the assumptions and the result in Equation (3), we can derive the following comparative static results for the impact on ω

$$\begin{aligned} \frac{d\omega}{dX} &= \frac{r_X}{C_{\omega\omega}} > 0 \\ \frac{d\omega}{dZ} &= \frac{-C_{\omega Z}}{C_{\omega\omega}} < 0. \end{aligned} \tag{7}$$

Thus, wage arrears should be positively related to the firm's cost of capital and to the ability of managers to appropriate cash flow and earn private benefits. They should be negatively related to the difficulty of monitoring the worker, to the value of the worker's outside alternatives, to the strength of worker organization, and to the effectiveness of the legal system. Finally, factors that reduce quit rate increase the probability of having wage arrears (specific human capital, employee ownership, high search and mobility costs, etc.).

Differentiating the reaction function (5) with respect to Ω (while holding constant the variables in X and Z) yields

$$\frac{d\omega}{d\Omega} = -\frac{C^{(-)}_{\omega\Omega}}{C_{\omega\omega}} > 0. \tag{8}$$

Thus, a direct implication of our model is that wage payment decisions exhibit positive neighborhood effects. In the next section, we present our empirical estimates of a linear reaction function, followed by an empirical analysis of the feedback loops (in Section 5) and an example of a nonlinear reaction function implying the possibility of multiple equilibria (in Section 6).

4. Estimating the Linear Reaction Function

Our first tests of the model focus on the most important implication, the positive slope of the reaction function ($\partial\omega/\partial\Omega > 0$). We also examine the model implications that proxies for X raise ω and that proxies for Z lower ω, while postponing analysis of the feedback loops until the next section. We first discuss our identification strategy and then present results.

4.1. Identification Strategy

To test for positive feedback in the reaction function, we assume a linear functional form for Equation (5). Estimating the function directly by ordinary least squares (OLS) may produce the standard identification problems of any model of social interactions (e.g., Manski, 1993; Moffitt, 2001). As an illustration, consider the following model of endogenous interactions for two firms (for simplicity, each with one employee), indexed by i and k:

$$\begin{aligned}\omega_{ijt} &= \beta_0 + \beta_1\Omega_{(-i)jt} + \beta_2 X_{ijt} + \beta_3 Z_{ijt} + \tau D_t + u_{ijt}\\ \omega_{kjt} &= \beta_0 + \beta_1\Omega_{(-k)jt} + \beta_2 X_{kjt} + \beta_3 Z_{kjt} + \tau D_t + u_{kjt},\end{aligned} \tag{9}$$

where ω_{ijt} is the number of unpaid monthly wages of firm i in district j in period t; $\Omega_{(-i)jt}$ is the level of wage arrears in the rest of the firm's local labor market (district) j in period t; X_{ijt} and Z_{ijt} are the vectors of observable factors affecting returns to and cost of using wage arrears, respectively; D_t is a set of year dummy variables; and the u's are error terms.

A first identification problem arises if omitted unobservables are correlated with Ω and also correlated across firms and workers within a local labor market. Examples of such omitted variables that could produce $\text{Cov}(u_{ijt}, u_{kjt}) \neq 0$ in our model include differences across districts in

resources, demand conditions, legal environment, or social norms such as tolerance towards contract violation. The problem of correlated unobservables that are time-invariant may be handled by exploiting the panel features of the data:

$$\omega_{ijt} = \beta_1 \Omega_{(-i)jt} + \beta_2 X_{ijt} + \beta_3 Z_{ijt} + \tau D_t + \theta_j + \varepsilon_{ijt}, \quad (10)$$

where X_{ijt} and Z_{ijt} include time-varying observable characteristics and θ_j are local labor market (district) fixed effects. There could also be correlated unobservables at the level of firms (i.e., the propensity to violate the wage contract could be correlated within local labor markets) and workers (i.e., the probability of not being paid could vary). To address these problems, we exploit the presence of many firms with multiple workers in our data and the existence of multiple observations on each worker in the panel, permitting us to include firm and worker fixed effects and take into account variation in time-invariant unobserved heterogeneity along these dimensions. In all cases, the adjustment of standard errors for clustering within districts will be necessary for proper inferences.

A second identification issue arises when the error terms are correlated due to firm interdependence in the level of wage arrears: $\omega_{ijt} \Rightarrow \Omega_{(-k)jt} \Rightarrow \omega_{kjt} \Rightarrow \Omega_{(-i)jt} \Rightarrow \omega_{ijt}$, Manski's (1993) "reflection problem." In the spirit of Moffitt (2001), our identification strategy is to search for exogenous interventions that alter wage arrears for some workers but not for others. We exploit the fact that nonpayment of wages in the public sector is driven by a different process—governmental financing and revenue-sharing decisions—than wage delays in the nonpublic sector, which are driven by the considerations in our model. Indeed, while data on the early period are scarce, we believe the initial burst of arrears in Russia was caused by the sequestration of budgetary funds by the Ministry of Finance in the early and mid-1990s. Only very incomplete accounts of the extent of sequestration are available, but according to many observers the amounts were large.[23] According to the Institute for the Economy in Transition (1994, p. 35), for example, every expenditure line in the fourth quarter of the 1993 federal budget was sequestered by 20 percent. Rather than shutting the government down, as occasionally happens in the US during budgetary disputes between the president and Congress, the Russian government

[23] The motive for sequestration was to reduce the budget deficit and inflation following price liberalization in 1992; the deficit target figured strongly in IMF loan agreements at the time, and some policymakers even boasted of sequestration as a clever way to satisfy conditionality.

continued to operate, government contractors continued to supply government orders, and state employees continued coming to work even when they began to be paid irregularly. Unfortunately, detailed data on these early stages of wage arrears are unavailable.

An identification solution is thus to use arrears practice in the public sector to identify neighborhood effects in the nonpublic sector. Assuming two nonpublic firms, *i* and *k*, and one aggregated public sector firm, *p*, the model becomes

$$\begin{cases} \omega_{ijt} = \beta_1 \Omega_{(-i)jt} + \beta_2 X_{ijt} + \beta_3 Z_{ijt} + \tau D_t + \theta_j + \varepsilon_{ijt} \\ \omega_{kjt} = \beta_1 \Omega_{(-k)jt} + \beta_2 X_{kjt} + \beta_3 Z_{kjt} + \tau D_t + \theta_j + \varepsilon_{kjt} \\ \omega_{pjt} = \beta_{2p} X_{pjt} + \beta_{3p} Z_{pjt} + \tau_p D_t + \theta_{pj} + \varepsilon_{pjt} \end{cases} \tag{11}$$
$$Cov(\varepsilon_{ijt}, \varepsilon_{pjt}) = Cov(\varepsilon_{kjt}, \varepsilon_{pjt}) = 0,$$

where coefficients are permitted to vary between the nonpublic and public sector equations. The identifying assumption is that $\Omega_{(-p)jt}$, the level of wage arrears in the rest of the public sector's district *j* in period *t*, does not enter the equation for ω_{pjt} — in other words, that wage arrears in the public sector are determined by bureaucratic decisions in the federal and regional governments that are unrelated to arrears of nonpublic firms in the local area.

In these Equations (11), $\Omega_{(-i)jt}$ equals the sum of average wage arrears in the public and nonpublic sectors, weighted by the share of workers in the corresponding sectors:

$$\Omega_{(-i)jt} = \frac{1}{N_{jt}} \left(\sum_{k \neq i} \omega_{kjt} + \sum_{p} \omega_{pjt} \right) = \overline{\omega}_{njt} \left(1 - n_{pjt}\right) + \overline{\omega}_{pjt} n_{pjt}, \tag{12}$$

where $\overline{\omega}_{pjt}$ and $\overline{\omega}_{njt}$ are the average wage arrears in the public and nonpublic sectors respectively (again excluding firm *i*), and n_{pjt} is the share of workers in the public sector. The first term in $\Omega_{(-i)jt}$ is endogenous, while the second term is exogenous. Therefore, we can employ $\overline{\omega}_{pjt} = \Omega_{pjt}$ and n_{pjt} as instruments, capturing both the magnitude of average arrears that appear exogenously and the relative share of this exogenous component in total regional arrears.

The identifying assumption of no interaction effects in the public sector is more likely to hold for the parts of the public sector that are funded exclusively by the federal government. For this reason, we also employ an alternative set of instrumental variables, including $\overline{\omega}_{djt} = \Omega_{djt}$, the average local arrears in the defense sector, and n_{djt}, the share of workers in the defense sector in district *j* in year *t*. These can be motivated by a similar decomposition of Equation (12) into the

defense and nondefense parts of the public sector. We also use another instrumental variable driven by public decisions but not related to arrears in the nonpublic sector: the share of pensioners who did not receive their pension in the previous month.

A third potential identification issue in estimating the wage arrears reaction function is the possibility that the reference group is endogenous. Analogously to the choice of peer group in studies of teenage behavior (e.g., Evans et al., 1992), it is possible that firms and workers sort themselves across districts with respect to their returns, costs, and tolerance of arrears. The clustering of arrears within districts might merely reflect the tendency for similar agents to locate close to one another. Our inclusion of district-level fixed effects controls for this possibility, but in any case such geographic sorting seems quite implausible, particularly in the Russian case. An oft-noted feature of Russian labor markets is the low geographic mobility of labor, explained by information problems, poorly functioning housing markets, and lack of liquidity (Mitchneck and Plane, 1995; Heleniak, 1997; Friebel and Guriev, 2002; and Andrienko and Guriev, 2004). All evidence implies that Russian regions are poorly integrated, and worker mobility across regions can act only slowly to affect regional differences.

4.2. Results

Our discussion of identification issues implies the value of alternative approaches to estimation. We first provide OLS results of the reaction function, then in turn we add district, firm, and worker fixed effects (FE), and then we use various combinations of instrumental variables (IV). Each of the FE specifications focuses on a different type of unobserved heterogeneity: the district and firm FE represent fixed components of the X vector of characteristics raising the return to delaying wages, while the worker FE represent time-invariant components of the X and Z vectors. Because both firms and workers are nested within districts, the firm and worker FE specifications also remove any fixed differences across districts. In all cases, we compute robust standard errors adjusted for clustering within districts.

The basic OLS and FE estimation results for the linear reaction function in the nonpublic sector are shown in Table 4. The estimated β (the coefficient on Ω) is positive and statistically significant at the 1 percent level in the OLS and all 3 FE specifications. The range of

magnitudes is from about 0.6 (with district FE) to almost 1.0 (with firm FE). These results provide some initial evidence of strong neighborhood effects in the violation of wage contracts.

The other variables in Table 4 represent Z variables that are worker characteristics affecting the firm's costs of delaying wages. The results are quite similar across specifications as well as to results in previous research using earlier data: Wage arrears are higher for men, but they vary little with schooling, age, or family income. The negative effect of tenure is consistent with the interpretation that longer tenured workers have relatively poor outside alternatives (Lehmann et al., 1999). But the magnitudes are not large, indicating an additional one month arrears for a worker with 30 years of tenure compared to a new hire. The hourly wage has a negative coefficient, which Desai and Idson (2000) interpret as suggesting that managers delay wages to less productive workers. In our data, the relationship is weak, implying an increase of about 0.1 monthly wages associated with a rise of two standard deviations in the hourly wage. A final result is the positive impact of small share ownership, which may be interpreted to imply that managers delay wages to acquire shares from their workers (Earle and Sabirianova, 2002).

Results for IV specifications of the reaction function for the nonpublic sector are presented in Table 5. Aside from instrumenting Ω, the specifications are otherwise the same as in Table 4 and the results for other variables are quite similar, so we omit them to save space. We show the results for 3 alternative sets of the instruments: specification 1 includes n_p, the district share of employees working in the public sector, and Ω_p, the average arrears among public sector employees in the district; specification 2 includes n_d, the district share of employees working in the defense sector, and Ω_d, the average arrears among defense sector employees in the district; and specification 3 adds the local share of pensioners with arrears. As discussed in the previous subsection, we motivate the use of wage arrears in the defense sector and pension arrears as identifying restrictions by the fact that decision-making about payments in these cases is purely federal and therefore unlikely to take into account local conditions.

In each specification in Table 5, the estimated coefficient on Ω is positive, large and statistically significant at the 1 percent level. The precise magnitude varies somewhat across specifications, but the range is similar to that in Table 4. In each case, the first-stage results

show that the excluded instruments are not weak and significantly increase Ω. In specification 1, however, the value of the Hansen *J* statistic suggests that the data marginally reject exogeneity of n_p and Ω_p, which could result from reverse feedback from the nonpublic to the public sector.

To investigate this more fully, Table 6 reports the results from estimating reaction functions for the public and defense sectors. Each cell in the table represents a separate specification, defined by sample (public or defense), definition of the district arrears (total district arrears Ω, or just district arrears in the nonpublic sector Ω_n), and controls for unobserved heterogeneity (OLS and FE by district, firm, and worker). The results show much weaker but still positive neighborhood effects in the public sector, compared to the reaction functions in Tables 4 and 5 for the nonpublic sector. This suggests that managers of public organizations in their payment decisions are likely to be influenced by the local environment of wage contract violation and thus public sector arrears might not be ideal instruments. At the same time, Table 6 shows no significant feedback from either Ω or Ω_n to arrears in the defense sector. These results, which are consistent across estimation methods, support our use of the defense sector variables as instruments in the nonpublic sector reaction function reported in Table 5. Our empirical analysis fails to reject the exogeneity of federal-level instrumental variables—n_d, Ω_d, and pension arrears—even after controlling for unobservable worker and firm characteristics and adjusting for clustering of errors within districts. The standard diagnostic tests suggest that these are valid instruments and none of them are redundant. The IV specifications unambiguously imply strong positive interactions in the nonpublic sector, as our model predicts.

5. Estimating the Feedback Loops

This section presents empirical estimates of feedback loops that may increase the strength of neighborhood effects (Section 5.1) and the possibility of wage adjustments (Section 5.2).

5.1. Effort, Quits, Strikes, and Legal Penalties

We draw upon both the worker and the firm data to construct proxy variables for the four types of costs of arrears discussed in the model, and summary statistics for these variables are displayed in Tables 2 and 3. The variables "actual hours of work," "desire to switch jobs," and "job separations" are measured from the RLMS, while "quit rate," "strikes and other forms of

protest," and "legal penalties" are drawn from the enterprise survey. We argue that the first two variables—actual hours of work and desire to switch jobs—proxy for morale and job satisfaction which are likely to influence work effort. In addition, it is sometimes argued that Russian workers reduce their hours in response to arrears (Aslund, 1997), providing an additional motivation for examining the effects of ω and Ω on work hours.

We analyze two measures of worker turnover. The first, based on the RLMS panel, defines a job separation as no longer working for the employer two years later. This includes all types of separations, but available evidence strongly indicates that the share of involuntary separations is very low in Russia—generally less than 10 percent (e.g., Brown and Earle, 2003). The second measure, derived from the firm survey data, includes voluntary separations only, is expressed as a ratio to average firm employment, and refers to a one-year period.

The final two potential costs of arrears are also measured at the firm level. "Strikes" refer not only to formal work stoppages but also to other forms of protests, such as hunger strikes and work slowdowns. The data imply they are much more common in firms reporting wage arrears than in those not, and wage arrears were by far the most commonly cited reason for strikes by firms reporting them in response to a direct question. "Legal penalties" refer specifically to fines for wage arrears, which are imposed by either a civil court or the Labor Inspection Service. Both of these are dummy variables, and their means over the firm-years in the sample are shown in Table 3. The incidence of both variables is very low in the early 1990s but becomes more substantial in the second half of the decade.

Recall from Section 3.1 the model assumptions of $C_{\omega} > 0$ and $C_{\omega\Omega} < 0$: the costs of not paying wages exhibit positive feedback in the sense that the costs of arrears are reduced on the margin when other firms in the local labor market tend to have higher arrears. If this is correct, then each of these types of costs represents a feedback loop that contributes to self-propagation of the practice of wage contract violation.

The critical assumption of a negative cross-partial derivative may be directly tested using an interaction term in each equation. The relationship between the costs of using wage arrears and the wage arrears environment can be presented in linear form as follows:

$$C_{ijt} = \beta_{\omega}\omega_{ijt} + \beta_{\Omega}\Omega_{(-i)jt} + \beta_{\omega\Omega}\omega_{ijt}\Omega_{(-i)jt} + \gamma Z_{ijt} + \pi D_t + \theta_j + \varepsilon_{ijt}, \quad (13)$$

where C_{ijt} are proxy measures for wage arrears costs such as hours of work, desire to switch jobs, quits, strikes, and legal penalties; ω_{ijt} is the number of unpaid monthly wages of individual i working in district j in period t; $\Omega_{(-i)jt}$ is the level of wage arrears in the rest of the firm's local labor market (district) j in period t; Z_{ijt} is a vector of time-varying observable individual characteristics (hourly wage rate, family income, schooling, tenure, occupation, and employee ownership) and firm characteristics (industry, union density, fringe benefits, and training costs); D_t is the set of year dummy variables; and θ_j are local labor market (district) fixed effects.

Table 7 shows estimates from the worker survey data for the functions with desire to change jobs, hours of work, and job separation as dependent variables. The impact of ω on a worker's hours and desire to switch jobs is reduced by Ω (so that $E_{\omega\Omega} < 0$). Computing $\partial(Hours)/\partial\omega$ at alternative levels of Ω, we find that workers in low-Ω regions reduce their hours in response to their own arrears, so that if $\Omega = 0$, hours fall 1.46 hours per month for each one month increase in ω and workers with $\omega = 6$ work about 2 hours less per week than those with $\omega = 0$. But $\partial(Hours)/\partial\omega$ falls as Ω rises, and at $\Omega = 8.6$ months, the effect vanishes entirely. Similarly, the probability that an individual reports a desire to switch jobs increases by 2.4 percent for each month of ω in regions where $\Omega = 0$. Given an overall average probability of 38 percent, this effect implies that an individual who has six months' arrears and lives in a low arrears region would be 50 percent more likely to desire a job change compared to an otherwise identical neighbor with no wage arrears. But the effect declines with Ω such that the point estimates suggest it becomes negligible at about $\Omega = 10$.

Table 7 also shows the estimated job separation function using individual data. Again, the results imply $Q_{\omega} > 0$ and $Q_{\omega\Omega} < 0$ for this component of costs. When $\Omega = 0$, the separation probability is estimated to increase by nearly 1 percentage point for each one-month rise in ω, and as Ω rises the estimated response to ω declines, becoming negative after $\Omega = 5$. These estimates are again consistent with our hypothesis that wage arrears are strategic complements for managers of firms operating in the same local labor market.

Table 7 results concerning the vector of Z controls in the regressions are fairly standard: the hours equation shows a slight tendency towards backward-bending in the hourly wage rate (the magnitude suggests that a 1000 ruble increase in the wage, about 11 percent, would decrease hours by 1.25 hours per month), while nonlabor (family) income has a negative sign, and male gender, schooling, and age are all positively associated with hours. The regression for desire to switch jobs shows that the probability declines with the contractual wage and with job tenure. In the quit function, results for the Z controls show that male gender is positively associated while schooling and tenure are negatively associated with the quit probability.

Turning to the feedback functions using the firm survey data, we specify the Z vector to include dummies for industry, year, and type of location (four city-type categories) in all equations. The quit rate and strike probability functions also include union density (percentage of employees who are union members), provision of fringe benefits (training, kindergartens, and housing), and training costs for new employees (measured as number of days required in initial training). The legal penalties equation includes proxies for the legal environment in the subject of the Russian Federation drawn from the Ministry of Labor's Inspection Service in 1997. One variable is the ratio of uncollected fines to the total number of fines assessed on managers because of labor violations, which we interpret as reflecting (inversely) the strength of the legal system in carrying out at least those punishments it does assess: managers would have relatively little to fear in regions where this ratio is high. A second measure is the fraction of cases where wage arrears were paid off after they were found by (or reported to) the Inspection Service. Summary statistics for all these controls are reported in Table 3.

For all three dependent variables, the results in Table 8 show that Ω tends to lessen the impact of ω on the costs to the firm of using arrears: $Q_{\omega\Omega} < 0$, $S_{\omega\Omega} < 0$, and $L_{\omega\Omega} < 0$. The magnitudes imply that when $\Omega = 0$ the quit rate rises by about 1 percentage point for each one-month rise in ω and the strike probability by about one-third of a point, so that if $\omega = 8$ the quit rate rises by 50 percent and the strike rate more than doubles relative to the situation with no wage arrears. The estimated effect on the probability of legal penalties is weaker, but again it

declines as Ω increases. These costs of wage arrears are virtually vanishing in the observed range of behavior.

Concerning the results for other variables, union density, training provision, and the level of training costs are estimated to reduce the quit rate. The effect of union density on the strike probability is statistically insignificant, a result consistent with the assessment that Russian unions are weak (e.g., Gimpelson and Lippoldt, 2001). The fraction of cases where managers failed to pay assessed fines on time is estimated to have a negative impact on the probability of legal penalties, which we interpret as a reflection of the effectiveness of local legal institutions. The negative impact of the fraction of cases in which arrears were paid off is puzzling, although it may reflect the lower likelihood of penalties if managers quickly pay after they are found out. In any case, the results for all four components of costs strongly support the hypothesis of positive feedback loops, suggesting there may be increasing returns to the use of wage arrears.

5.2. Wage Adjustment

Our model and empirical methods treat wage rates as exogenous with respect to wage arrears. The assumption follows from the institutions of wage determination in Russia, where wages in large companies, responsible for most arrears, are set in collective bargaining agreements at a frequency of one or two years. By contrast, the decisions on arrears—whether to delay payment, to pay partial wages, and to repay any overdue back wages—are taken monthly. Thus, at the moment of deciding on arrears, the wage is predetermined. Moreover, there is no negotiation of wage arrears in collective bargaining. The concept of such a negotiation is a logical self-contradiction involving a contract to violate a contract. It would be completely unenforceable, even more than the contractual wage rates themselves.[24] Wage arrears cannot be specified, agreed to, and fixed *ex ante*; by their very nature, they are noncontractible.

Nevertheless, to provide some empirical evidence on this question, let us assume for the moment that it were possible for the worker and the firm to agree on both a contractual wage rate and a magnitude of wage arrears. If arrears are a disamenity for workers—like danger, risk of layoff, or lack of fringe benefits—then there should be a positive compensating differential

[24] Trade union leaders interviewed by the authors in Moscow completely rejected the possibility that the extent of wage contract violations could ever be negotiated with management.

associated with them: they should be positively related to contractual wages. The standard way of estimating the equalizing difference that workers place on such job characteristics is the familiar hedonic wage function (e.g., Rosen, 1974), wage arrears as an independent variable. Results from estimating various versions of such a function are displayed in Table 9. In some specifications, we instrument the worker's ω with the district's Ω. While the wage equations otherwise show fairly standard shapes (large male premium, positive returns to schooling, concave profile in experience), in no case is there a positive coefficient on ω. The data do not support a trade-off between wage rates and wage arrears, and by implication they reject the notion of an implicit market in the extent to which firms keep their wage promises.[25]

6. Estimating a Nonlinear Model of Wage Arrears Interactions

Returning to the model in Section 3, we obtain the reaction function's second derivative:

$$\frac{d^2\omega}{d\Omega^2} = \frac{C_{\omega\omega\Omega}\overset{(-)}{C_{\omega\Omega}} - C_{\omega\Omega\Omega}\overset{(+)}{C_{\omega\omega}}}{C_{\omega\omega}{}^2} \gtrless 0, \tag{14}$$

which may be positive as well as negative. Multiple equilibria require sign switching. Such a case, where the second derivative is initially positive and then turns negative after Ω exceeds the inflection point Ω_I, is shown in Figure 1. To motivate this case more fully, we next consider a particular functional form for the cost function, one from which we derive an estimable reaction function that permits the possibility of multiple equilibria.

6.1. A Particular Functional Form for Estimation

Consider the following special form of the cost function:

$$C = \omega \cdot \left(a\omega - b\Omega - c\Omega^2 + d\Omega^3 + eZ\right), \tag{15}$$

which may generate multiple Nash equilibria, as we show below. We will again assume that the cost function satisfies the following conditions:

[25] Furthermore, none of our results in Tables 4–6 and 8–9 are altered more than slightly if we simply drop the wage rate from the equations.

$$C_{\omega} = 2a\omega - b\Omega - c\Omega^2 + d\Omega^3 + eZ = a\omega + \frac{C}{\omega} > 0$$
$$C_{\Omega} = \omega\left(-b - 2c\Omega + 3d\Omega^2\right) < 0$$
$$C_{\omega\omega} = 2a > 0 \qquad \Rightarrow \qquad a > 0$$
$$C_{\omega\Omega} = -b - 2c\Omega + 3d\Omega^2 = \frac{\overset{(-)}{C_{\Omega}}}{\omega} < 0$$
$$C_{\omega Z} = e > 0. \tag{16}$$

Parameters *a* and *e* are positive by virtue of our earlier assumptions, but we also hypothesize that *c* and *d* are positive, while the sign of *b* is ambiguous, for reasons that we discuss shortly. The first-order condition of maximizing the objective function implies the equality of marginal return and marginal cost associated with wage arrears:

$$\max_{\omega} \ \pi = r\omega - \omega\left(a\omega - b\Omega - c\Omega^2 + d\Omega^3 + eZ\right) \tag{1'}$$

$$r = 2a\omega - b\Omega - c\Omega^2 + d\Omega^3 + eZ\,. \tag{4'}$$

From the first order condition we can derive an estimable reaction function:

$$\varpi = \frac{b\Omega + c\Omega^2 - d\Omega^3 + r - eZ}{2a}\,, \tag{5'}$$

where ϖ is a cubic function of Ω.

The reaction function exhibits positive feedback:

$$\frac{\partial \varpi}{\partial \Omega} = \frac{b + 2c\Omega - 3d\Omega^2}{2a} = -\frac{\overset{(-)}{C_{\omega\Omega}}}{2a} > 0\,. \tag{8'}$$

But the sign of the second derivative is ambiguous:

$$\frac{\partial^2 \varpi}{\partial \Omega^2} = \frac{c - 3d\Omega}{a} \gtrless 0\,, \tag{13'}$$

depending on *c*, *d*, and Ω. For fixed *c* and $d > 0$, the reaction function exhibits a cubic S-shape with inflection point at $\Omega_i = c/3d$. At lower levels of local labor market arrears ($\Omega < c/3d$) the response function is convex, and at higher levels it is concave. We test these implications below.

6.2. Equilibrium Wage Arrears

In symmetric Nash equilibrium, where all firms in a local labor market face identical return and cost functions and where they take each other's actions as given, the level of firm wage arrears must be equal to the level of regional wage arrears ($\omega^* = \Omega^*$), which implies

$$-d\omega^{*3} + c\omega^{*2} + (b - 2a)\omega^* + r - eZ = 0\,. \tag{17}$$

It is possible to solve this equation analytically for three equilibria in terms of *a*, *b*, *c*, *d*, *e*, *r*, and *Z*, but the equations describing the solutions are very long (several pages each). To simplify for illustrative purposes, we note that $r-eZ > 0$ implies that even if no other firms in the region have wage arrears ($\Omega=0$), the net return to wage arrears is still positive, implying $\omega > 0$. Since most economies are characterized by regular payment of wage obligations, we normalize the results, assuming $r=eZ$, which implies simple analytical solutions for wage arrears equilibria:

$$\begin{aligned} \omega_1^* &= 0 \\ \omega_2^* &= \frac{c - \sqrt{c^2 + 4d(b-2a)}}{2d} \\ \omega_3^* &= \frac{c + \sqrt{c^2 + 4d(b-2a)}}{2d} \end{aligned} \quad . \tag{18}$$

The first equilibrium involves zero firm wage arrears at zero regional wage arrears, while positivity of the second requires $4d(b-2a)<0$, implying restrictions on *a* and *b* such that $b/2a<1$. *b* may be positive or negative, although our hypotheses imply a generally positive slope.

We may label ω_1^* the "contracts honored" or "punctual payment equilibrium," ω_2^* the "critical mass" or "threshold equilibrium," and ω_3^* the "contracts breached" or "wage arrears equilibrium." ω_1^* and ω_3^* are stable and ω_2^* is unstable, as the Appendix shows. Figure 2 displays the symmetric Nash equilibria and the dynamics implied by the model. In the range where $\omega_1^* < \Omega < \omega_2^*$, a self-interested manager will choose $\omega < \Omega$, so optimizing behavior by all managers will tend to drive down Ω. Beyond ω_2^*, managerial behavior will tend to push up Ω until it reaches ω_3^*, the stable late payment equilibrium.

6.3. Nonlinear Estimation Results

Multiple equilibria may arise when the reaction function has an S-shape, so that at low levels of Ω, $\partial^2\omega/\partial\Omega^2 > 0$, while at higher levels $\partial^2\omega/\partial\Omega^2 < 0$. The functional form of the manager's objective that we have employed as an example (Equation (1') above) suggests a cubic form for the reaction function, with alternating signs on the coefficients in the polynomial on Ω. More specifically, we can test that the critical parameters *c* and *d* are both positive, while $b/2a<1$.

We therefore estimate the reaction function (5'). Decomposing the Z vector into observable and unobservable components leads directly to our estimating equation:

$$\omega_i = \beta_0 + \beta_1\Omega_i + \beta_2\Omega_i^2 + \beta_3\Omega_i^3 + \beta_4 X_i + \beta_5 Z_i' + \xi_i, \quad (19)$$

where we use the subscript i to index individual workers, and where $\beta_1 = b/2a$, $\beta_2 = c/2a$, and $\beta_3 = -d/2a$, $\beta_4 = r'(X_i)/2a$ and $\beta_5 = -e/2a$. We have decomposed the vector of Z controls to include a constant, β_0, a vector of observable characteristics, Z_i', and a residual reflecting an unobserved component in the cost function, ε_i; thus, $Z_i = \beta_0 + Z_i' + \varepsilon_i$, and $\xi_i = \varepsilon_i/2a$.

Brock and Durlauf (2001) argue that a nonlinear model of social interactions similar to Equation (19) is generically identified, but to examine robustness we report both OLS and FE estimates. In fact, as in the linear case, the inclusion of unobservable time-invariant effects at the district, firm, and worker level does little to alter the results, which are shown in Table 10. The results for X and Z variables are very similar to those in Table 4 and therefore are not displayed in Table 10, which contains our estimates of Equation (19).

Concerning the polynomial in Ω, one of the less obvious predictions of the theoretical model, emerging from the discussion above, was that $b/2a = \beta_1 < 1$. This implication is satisfied by all the estimates in Table 10, and in all cases we can reject the hypothesis that $\beta_1 = 1$ at the 1 percent level. This is also a necessary condition for stability of the extreme equilibria. The signs of the estimates of c and d are also consistent with the theoretical model in all four estimated models, and they are statistically significant.

The nonlinear estimation results continue to support the hypothesis of positive neighborhood effects over most of the relevant range. Only when district fixed effects are included is β_1 statistically significantly less than zero, and even in this case, the reaction function is estimated to have a positive slope for $\Omega > 1.6$. In all cases, the point estimates of the coefficients imply an S-shaped reaction function.

6.4. Simulating Symmetric Nash Equilibria

Whether an S-shaped reaction function produces multiple equilibria depends on the magnitudes of the parameters. Using the estimated parameters of the empirical reaction

function, we may simulate symmetric Nash equilibria and calculate the levels of arrears consistent with the two stable equilibria and with the unstable critical mass threshold.

Figure 3 graphs the estimated reaction function, taking the average of $\beta_0 + \beta_4 X_i' + \beta_5 Z_i'$ across all individuals in the sample, which then becomes the intercept for the plotted relationship. Under the assumption of symmetric Nash behavior in local labor markets, it is straightforward in principle to solve the estimated reaction functions for the set of average equilibria across regions. Figure 3 does this in the simplest way, by finding the intersection between the reaction function and a 45° ray from the origin.

As is evident from the figure, the results suggest there are indeed multiple equilibria. The average punctual payment equilibrium in Russian regions involves less than one monthly wage debt, the critical mass equilibrium is 5.5 months, and the late payment equilibrium is 9.5 months. The estimates imply stability of the extreme equilibria ω_1^* and ω_3^* and instability of the threshold ω_2^*. Thus, the data provide support for some of the model's crucial details as well as the most important predictions of positive feedback and multiple equilibria.

6.5. Equilibrium Selection and Robustness

If there are multiple equilibria in wage arrears, how do countries or regions get into the punctual payment or the late payment equilibrium? A natural candidate for selecting the equilibrium would be a large employer, big enough to move the equilibrium from one side of the critical mass threshold to the other by setting a standard that other employers follow. In the Russian case, we would argue that role was played by the state, which as we have discussed initiated late payments on a large scale by budgetary sequestration to reduce the fiscal deficit. It is notable that the share of employment accounted for by the public sector was actually growing through most of this standard-setting period.[26]

How robust is the late payment equilibrium? For instance, while our analysis has focused on symmetric Nash equilibria, what prevents some firm, say a new entrant, from violating the late-payment norm by offering workers a lower wage, but one paid regularly on time? Our

[26] According to OECD (1997), employment in public administration grew steadily from 663,000 in 1990 to 1,087,000 in 1995, or from 0.88 to 1.64 percent of total employment.

model shows that identical firms will not defect from the late payment equilibrium, but in practice there is likely to be heterogeneity, particularly in the case of new start-ups. Firms with profitable opportunities seeking to hire new employees may try to build a reputation for punctual payment if workers care about this characteristic of their jobs.

While such a process may sometimes occur in a number of regions of Russia, in order to explain why it does not unravel the late payment equilibrium in regions with persistently high arrears we must call upon other aspects of the Russian environment, including the severe recession and the continual instability and illiquidity. The large fall in output and consumption has reduced the profitability of entry, and the continual instability has made it difficult for firms to establish reputations. We can imagine a signaling game in which there are two types of firms: in one type, where prospects are poor, managers simply try to steal wages; in the other, which has profitable projects, managers try to pay workers and build a reliable reputation in order to increase effort and reduce turnover. But the type of firm is unobservable to workers, and all managers can announce (as they do in reality) their most sincere intentions to pay wages "as soon as the firm has money." In this situation, the ability of the second type of managers to distinguish themselves from the first type amounts to the possibility for existence of a separating equilibrium. If economic instability is so great that occasional shocks hit every firm with some probability, rendering them temporarily unable to pay, then firms cannot build a reputation and workers may not be able to distinguish the firm types in practice. This analysis is outside our formal model, and it is very difficult to verify empirically, but it does explain why a late payment equilibrium may be robust even when new entry and firm heterogeneity are permitted.

7. Conclusion

This paper has developed and tested several key features of a model of local labor market interactions in employer decisions to violate wage contracts. Our simple model provides a framework for understanding how such interactions may arise through the relationship between the costs to employers of using arrears and the extent of arrears in the local labor market environment. It also provides some guidance for empirical estimation of the reaction function

and of the feedback loops that may support a timely or late wage payment practice. Under certain circumstances, the model also suggests the possibility of multiple equilibria.

Our empirical analysis provides strong evidence of positive feedback in the manager's choice of wage arrears from the behavior of other firms operating in the same local labor market. Rational managers do indeed appear to take into account the wage arrears behavior of neighboring employers when choosing their own strategies. This result for the nonpublic sector of the Russian economy is robust to the inclusion of fixed effects at the level of the worker, the firm, and the local labor market, and to the use of instrumental variables associated with the exogenous determination of arrears in the public sector.

Furthermore, the data provide strong support for the existence of several feedback loops. We find that higher wage arrears in the local labor market attenuate the positive impact of arrears on the worker's quit probability and the firm's quit rate. Higher local arrears also reduce the negative impact of a worker's arrears on measures of effort and work hours. They reduce the positive impact of arrears on the strike probability, and they reduce the impact of the level of a firm's arrears on the probability that a legal penalty will be assessed.

The final empirical results concern the nonlinear reaction function and the possibility of multiple equilibria in wage arrears. Our estimates of a cubic reaction function, derived from a particular functional form for the costs of arrears, imply a clear S-shape. The magnitudes of the parameters imply that the average Russian region may indeed face multiple equilibria. The estimates imply a threshold equilibrium of about 5.5 monthly wages and a late payment equilibrium of 9.5. We hasten to add that these results are merely illustrative of the method that can be used for addressing this issue, but we believe they are highly suggestive of the existence of multiple equilibria in the practice of wage contract violations.

If the practice of contract violation exhibits multiple equilibria, what are the welfare characteristics of the late versus the punctual payment equilibrium? Notwithstanding injunctions against wage delays reaching back to Moses, some observers praise wage arrears as a way of achieving wage flexibility and low unemployment in Russia (Layard and Richter, 1995; OECD,

1997).[27] We would argue on the contrary that wage arrears are far from a socially efficient mechanism for bringing about a given real wage cut: the reduction in utility is greater because of the uncertainty concerning the timing and probability of eventual payment.

It seems to us, however, that the major consideration in a normative evaluation of arrears stems from the importance of wage contracts to most individuals. The violation of those contracts reduces confidence in other labor and nonlabor contracts into which the individual might enter, and thus may undermine the development of contract enforcement and rule of law. North (1990) and others have argued these are critical institutions in promoting impersonal exchange, potentially accounting for much of the variation across countries in economic growth and performance. Our analysis provides a case study of the lock-in of an institutional practice that is inimical to these institutions and thus to the development of a healthy market economy.

[27] Among other biblical references to wage delays, Deuteronomy 24: 14-15 admonishes, "You shall not withhold the wages of poor and needy laborers, whether other Israelites or aliens who reside in your land in one of your towns. You shall pay them their wages daily before sunset, because they are poor and their livelihood depends on them; otherwise they might cry to the Lord against you, and you would incur guilt."

References

Akerlof, George A., "A Theory of Social Custom, of Which Unemployment May be One Consequence." *Quarterly Journal of Economics*, 94(4): 749–775, June 1980.

Akerlof, George A., "Labor Contracts as Partial Gift Exchange." *Quarterly Journal of Economics*, 97(4): 543–569, November 1982.

Andrienko, Yury, and Sergei Guriev, "Determinants of Interregional Mobility in Russia: Evidence from Panel Data." *Economics of Transition*, 12(1): 1–27, March 2004.

Aoki, Masa, *Toward a Comparative Institutional Analysis*. Cambridge, MA: MIT Press, 2001.

Arthur, Brian W., "Competing Technologies, Increasing Returns, and Lock-in by Historical Events." *Economic Journal*, 99(394): 116–131, March 1989.

Aslund, Anders, "Social Problems and Policy in Postcommunist Russia," in Ethan B. Kapstein and Michael Mandelbaum, eds., *Sustaining the Transition: The Social Safety Net in Postcommunist Europe*. New York: Council on Foreign Relations, 1997.

Azariadis, Costas, and Allan Drazen, "Threshold Externalities in Economic Development." *Quarterly Journal of Economics*, 105(2): 501–526, May 1990.

Bardhan, Pranab, "Corruption and Development: A Review of Issues." *Journal of Economic Literature*, 35(3): 1320–1346, September 1997.

Becker, Gary S., "A Theory of Social Interactions." *Journal of Political Economy*, 82(6): 1063–1093, November–December 1974.

Bernheim, Douglas, "A Theory of Conformity." *Journal of Political Economy*, 102(5): 841–877, October 1994.

Bikhchandi, Sushil, David Hirshleifer, and Ivo Welch, "A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades." *Journal of Political Economy*, 100(5): 992–1026, October 1992.

Blume, Lawrence E., and Steven N. Durlauf, "The Interactions-Based Approach to Socioeconomic Behavior," in Steven N. Durlauf and H. Peyton Young, eds., *Social Dynamics*, pp. 15–44. Washington, DC: Brookings Institution Press, 2001.

Brock, William A., and Steven N. Durlauf, "Interactions-Based Models," in James J. Heckman and Edward Leamer, eds., *Handbook of Econometrics*, Vol. 5, pp. 3297–3380. Amsterdam: Elsevier Science Publishers, 2001.

Brown, J. David, and John S. Earle, "The Reallocation of Workers and Jobs in Russian Industry: New Evidence on Measures and Determinants." *Economics of Transition*, 11(2): 221–252, June 2003.

Bulow, Jeremy I., John D. Geanakoplos, and Paul D. Klemperer, "Multimarket Oligopoly: Strategic Substitutes and Complements." *Journal of Political Economy*, 93(3): 488–511, June 1985.

Cooper, Russell, and Andrew John, "Coordinating Failures in Keynesian Models." *Quarterly Journal of Economics*, 103(3): 441–463, August 1988.

David, Paul A., "Clio and the Economics of QWERTY." *American Economic Review*, 75(2): 332–337, May 1985.

Desai, Padma, and Todd Idson, *Work without Wages: Russia's Nonpayment Crisis*. Cambridge, MA: MIT Press, 2000.

Dewatripont, Mathias, and Gerard Roland, "Transition as a Process of Large-Scale Institutional Change." *Economics of Transition*, 4(1): 1–30, May 1996.

Diamond, Peter A., "Aggregate Demand in Search Equilibrium." *Journal of Political Economy*, 90(5): 881–894, October 1982.

Durlauf, Steven N., "Multiple Equilibria and Persistence in Aggregate Fluctuations." *American Economic Review*, 81(2): 70–74, May 1991.

Earle, John S., and Klara Sabirianova, "How Late to Pay? Understanding Wage Arrears in Russia." *Journal of Labor Economics*, 20(3)*:* 661–707, July 2002.

Evans, William N., Wallace E. Oates, and Robert M. Schwab, "Measuring Peer Group Effects: A Study of Teenage Behavior." *Journal of Political Economy,* 100(5): 966–991, October 1992.

Friebel, Guido, and Sergei Guriev, "Should I Stay or Can I Go: Attaching Workers Through In-Kind Payments." Working paper, New Economic School, Moscow, 2002.

Gimpelson, Vladimir, "The Politics of Labour Market Adjustment: The Case of Russia." Collegium Budapest (Budapest) Discussion Paper No. 54, November 1998.

Gimpelson, Vladimir, and Douglas Lippoldt, *The Russian Labor Market: Between Transition and Turmoil.* Lanham, MD/Oxford, UK: Rowman and Littlefield, 2001.

Glaeser, Edward, Bruce Sacerdote, and José A. Scheinkman, "Crime and Social Interactions." *Quarterly Journal of Economics*, 111(2): 507–548, May 1996.

Glaeser, Edward, and José A. Scheinkman, "Non-Market Interactions," in Mathias Dewatripont, Lars P. Hansen, and Stephen Turnovsky, eds., *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress.* Cambridge: Cambridge University Press, 2002.

Goskomstat, *Overdue Wage Payments on January 1, 1999 (Statistical Bulletin).* Moscow: Goskomstat of Russia, 1999.

Greif, Avner, "Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition." *American Economic Review*, 83(3): 525–548, June 1993.

Greif, Avner, and Eugene Kandel, "Contract Enforcement Institutions: Historical Perspective and Current Status in Russia," in Edward Lazear, ed., *Economic Transition in Eastern Europe and Russia: Realities of Reform*. Stanford: Hoover Institution Press, 1995.

Greif, Avner, Paul Milgrom, and Barry R. Weingast, "Coordination, Commitment, and Enforcement: The Case of the Merchant Guild." *Journal of Political Economy*, 102(4): 745–776, August 1994.

Grodner, Andrew, and Thomas J. Kniesner, "Social Interactions in Labor Supply." Forthcoming in *Journal of the European Economic Association*, 2006.

Hadfield, Gillian K., "Contract Law is Not Enough: The Many Legal Institutions that Support Contractual Commitments," in Claude Menard and Mary Shirley, eds., *Handbook of New Institutional Economics*. Kluwer, 2004.

Heleniak, Timothy, "Internal Migration in Russia During the Economic Transition." *Post-Soviet Geography and Economics*, 38(2): 81–104, February 1997.

Institute for the Economy in Transition, *Russian Economy in 1993: Trends and Prospects*. Moscow: Institute for the Economy in Transition, 1994.

Javeline, Deborah, *Protest and the Politics of Blame: The Russian Response to Unpaid Wages.* Ann Arbor: University of Michigan Press, 2003.

Johnson, Simon, Daniel Kaufmann, and Andrei Shleifer, "The Unofficial Economy in Transition." *Brookings Papers on Economic Activity*, 2, 159–239, 1997.

Katz, Lawrence F., Jeffrey R. Kling, and Jeffrey B. Liebman, "Moving to Opportunity in Boston: Early Results of a Randomized Mobility Experiment." *Quarterly Journal of Economics*, 116(2): 607–654, May 2001.

Katz, Michael, and Carl Shapiro, "Technology Adoption in the Presence of Network Externalities." *Journal of Political Economy*, 94(4): 822–841, August 1986.

Kennan, John, "The Economics of Strikes," in Orley Ashenfelter and Richard Layard, eds., *Handbook of Labor Economics*. Amsterdam: Elsevier Science Publishers, 1986.

Kling, Jeffrey R., Jens Ludwig, and Lawrence F. Katz, "Neighborhood Effects on Crime for Female and Male Youth: Evidence from a Randomized Housing Mobility Experiment." *Quarterly Journal of Economics*, 120(1): 87–130, February 2005.

Layard, Richard, and Andrea Richter, "How Much Unemployment is Needed for Restructuring: The Russian Experience." *Economics of Transition*, 3(1): 35–58, March 1995.

Lee, Kevin C., and M. Hashem Pesaran, "The Role of Sectoral Interactions in Wage Determination in the UK Economy." *Economic Journal*, 103(416): 21–55, January 1993.

Lehmann, Hartmut, Jonathan Wadsworth, and Alessandro Acquisti, "Grime and Punishment: Job Insecurity and Wage Arrears in the Russian Federation." *Journal of Comparative Economics*, 27(4): 595–617, December 1999.

Levinson, Harold M., "Pattern Bargaining: A Case Study of the Automobile Workers." *Quarterly Journal of Economics*, 74(2): 296–317, May 1960.

Manski, Charles F., "Identification of Endogenous Social Effects: The Reflection Problem." *Review of Economic Studies*, 60(3): 531–542, July 1993.

Milgrom, Paul R., Douglass North, and Barry R. Weingast, "The Role of Institutions in the Revival of Trade: The Medieval Law Merchant, Private Judges, and the Champagne Fairs." *Economics and Politics*, 2(1)*:* 1–23, March 1990.

Milgrom, Paul, and John Roberts, "Rationalizability, Learning, and Equilibrium in Games with Strategic Complementarities." *Econometrica*, 57(6): 1255–1277, November 1990.

Mitchneck, Beth, and David A. Plane, "Migration and the Quasi-Labor Market in Russia." *International Regional Science Review*, 18(3): 267–288, 1995.

Moffitt, Robert A., "Policy Interventions, Low-Level Equilibria, and Social Interactions," in Steven N. Durlauf and H. Peyton Young, eds., *Social Dynamics*, pp. 45–82. Washington, D.C.: Brookings Institution Press, 2001.

Murphy, Kevin M., Andrei Shleifer, and Robert W. Vishny, "Industrialization and the Big Push." *Journal of Political Economy*, 97(5): 1003–1026, October 1989.

Murrell, Peter, "Evolution in Economics and in the Economic Reform of the Centrally Planned Economies," in C.C. Clague and G. Rausser, eds., *The Emergence of Market Economies in Eastern Europe*, pp. 35–53. Cambridge, MA, and Oxford: Blackwell, 1992.

North, Douglass C., *Institutions, Institutional Change, and Economic Performance*. New York: Cambridge University Press, 1990.

OECD Economic Surveys 1997–1998: *The Russian Federation*. Paris: OECD, 1997.

Oi, Walter Y., "Labor as a Quasi-Fixed Factor." *Journal of Political Economy*, 70(6): 538–555, December 1962.

Radio Free Europe/Radio Liberty (RFE/RL) Newsline, "Wage Arrears Swell." Vol. 8(81), pt. 2, April 30, 2004.

Rosen, Sherwin, "Hedonic Prices and Implicit Markets." *Journal of Political Economy*, 82(1): 34–55, January–February 1974.

Sacerdote, Bruce, "Peer Effects with Random Assignment: Results for Dartmouth Roommates." *Quarterly Journal of Economics*, 116(2): 681–704, May 2001.

Sah, Raaj K., "Social Osmosis and Patterns of Crime." *Journal of Political Economy*, 99(6): 1272–1295, December 1991.

Shapiro, Carl, and Joseph E. Stiglitz, "Equilibrium Unemployment as a Worker Discipline Device." *American Economic Review*, 74(3): 433–444, June 1984.

Stiglitz, Joseph E., "Alternative Theories of Wage Determination and Unemployment in LDCs: The Labor Turnover Model." *Quarterly Journal of Economics*, 88(2): 194–227, May 1974.

Swafford, Michael, et al., "Sample of the Russian Federation Rounds V, VI, and VII of the Russian Longitudinal Monitoring Survey." Technical Report, 1997.

U.S. Department of Labor, Employment Standards Administration, Wage and Hour Division, "FairPay Enforcement Statistics for 2003." http://www.dol.gov/esa/regs/compliance/whd/fairpay/statistics_2003.htm, 2006.

Weinberg, Bruce A., Patricia B. Reagan, and Jeffrey J. Yankow, "Do Neighborhoods Affect Hours Worked? Evidence from Longitudinal Data." *Journal of Labor Economics*, 22(4): 891–924, October 2004.

Woittiez, Isolde, and Arie Kapteyn, "Social Interactions and Habit Formation in a Model of Female Labor Supply." *Journal of Public Economics*, 70(2): 185–205, November 1998.

Young, H. Peyton, "The Evolution of Conventions." *Econometrica*, 61(1): 57–84, January 1993.

Young, H. Peyton, and Mary A. Burke, "Competition and Custom in Economic Contracts: A Case Study of Illinois Agriculture." *American Economic Review*, 91(3): 559–573, June 2001.

Appendix.

To check the three equilibria in Section 6.2 for stability, we may calculate the slope of the reaction function at the equilibrium points. Stable equilibria should have a reaction function slope less than one:

$$\left.\frac{\partial \varpi}{\partial \Omega}\right|_{\omega^*} = \frac{b + 2c\omega^* - 3d\omega^{*2}}{2a} < 1 \quad , \tag{A1}$$

which implies

$$b - 2a + 2c\omega^* - 3d\omega^{*2} < 0 \quad . \tag{A2}$$

We may check this condition for each equilibrium in turn. ω_1^* is clearly stable:

$$\left.\frac{\partial \varpi}{\partial \Omega}\right|_{\omega_1^*} = \frac{b}{2a} < 1 \quad . \tag{A3}$$

The second equilibrium is unstable: $\left.\frac{\partial \varpi}{\partial \Omega}\right|_{\omega_2^*} > 1$, since upon substitution of ω_2^* into (A1) we obtain

$$b - 2a + 2c\left(\frac{c - \sqrt{c^2 + 4d(b-2a)}}{2d}\right) - 3d\left(\frac{c - \sqrt{c^2 + 4d(b-2a)}}{2d}\right)^2$$
$$= \frac{\left(\overset{(+)}{\sqrt{c^2 + 4d(b-2a)}}\right)\left(c - \overset{(+)}{\sqrt{c^2 + 4d(b-2a)}}\right)}{2d} > 0. \tag{A4}$$

Finally, the third equilibrium is stable: $\left.\frac{\partial \varpi}{\partial \Omega}\right|_{\omega_3^*} < 1$ as

$$b - 2a + 2c\left(\frac{c + \sqrt{c^2 + 4d(b-2a)}}{2d}\right) - 3d\left(\frac{c + \sqrt{c^2 + 4d(b-2a)}}{2d}\right)^2$$
$$= \frac{\left(\overset{(+)}{\sqrt{c^2 + 4d(b-2a)}}\right)\left(-c - \overset{(-)}{\sqrt{c^2 + 4d(b-2a)}}\right)}{2d} < 0. \tag{A5}$$

Thus, we have found three equilibria and shown that two of them are stable and one is not stable. Figure 2 shows the symmetric Nash equilibria and the dynamics implied by the model. In the range where $\omega_1^* < \Omega < \omega_2^*$, a self-interested manager will choose $\omega < \Omega$, so optimizing behavior by all managers will tend to drive down Ω. Beyond ω_2^*, managerial behavior will tend to push up Ω until it reaches ω_3^*, the stable late payment equilibrium.

Table 1: Magnitude of Wage Arrears, Worker Data

	1994	1995	1996	1998	2000
Mean(ω)					
All sectors	1.10	1.11	1.92	3.00	1.14
Public sector	0.82	0.88	1.80	2.93	0.97
Defense sector	1.42	1.15	2.75	4.21	1.35
Mean($\omega \mid \omega > 0$)	2.75	2.73	3.27	4.82	4.24
Unconditional distribution (ω)					
ω = 0 month	0.603	0.593	0.415	0.379	0.731
= 1 month	0.149	0.156	0.149	0.122	0.111
= 2-3 months	0.164	0.170	0.250	0.219	0.085
= 4-6 months	0.055	0.055	0.134	0.163	0.032
= 7-9 months	0.014	0.007	0.025	0.046	0.007
> 9 months	0.016	0.019	0.028	0.072	0.034
Ω in Selected districts					
"A"	0.417	0.478	1.167	1.080	0.407
"B"	0.627	0.480	0.593	1.256	0.137
"C"	2.236	2.274	3.574	4.301	1.408
"D"	4.119	6.581	6.175	11.690	9.898
Observations	4667	4310	4050	3781	4000

Notes: ω = number of monthly wages reported overdue by an employee-respondent in year t; Ω = average number of monthly wages owed in the rest of the firm's local labor market. Sample consists of all employee-respondents in the RLMS. Districts are indicated as "A" through "D" because the RLMS data confidentiality agreement precludes the release of district names.

Table 2: Characteristics of the Worker Sample

Variable	Mean	Variable	Mean
Male	0.473	Hourly wage rate (rubles)	12.094
Schooling (years)	11.851		(20.033)
	(2.524)	Family income (thous. rubles)	0.961
Age (years)	39.024		(1.775)
	(11.800)	Industry	
Tenure (years)	8.180	Mining	0.023
	(9.068)	Machine building	0.109
Employee owns		Light and food	0.049
No shares	0.813	Other manufacturing	0.102
<1%	0.105	Agriculture/forestry	0.101
≥1%	0.036	Transportation	0.077
No information	0.046	Construction	0.071
		Private services	0.140
Occupation		Public services	0.329
Managers	0.039	Public sector	0.367
Professionals	0.155	Defense sector	0.053
Technicians	0.177	Pensioners with arrears	0.109
Clerks	0.072	Ω_t (local arrears)	1.612
Service workers	0.096		(1.472)
Craft workers	0.175	Monthly hours of work	147.804
Operators and assemblers	0.179		(73.686)
Unskilled workers	0.094	Desire to switch jobs	0.383
Army	0.013	Quit in two years	0.291

Notes: Observations=19316, except for hours (18556), desire to switch jobs (18812), and quits (9119). Sample consists of all employee-respondents with nonmissing values on wage arrears, schooling, age, tenure, occupation, and industry. Standard deviations are shown in parentheses.

Table 3: Characteristics of the Firm Sample

Variable	Mean	Variable	Mean
ω (number of monthly	1.175	Industry	
wages overdue)	(2.375)	Energy & fuel	0.088
Ω (local arrears)	1.146	Metallurgy & chemicals	0.081
	(1.321)	Machine building	0.318
Strikes (dummy)	0.019	Wood and building materials	0.105
Quit rate (quits/employment)	0.169	Light	0.089
	(0.169)	Food	0.135
Legal penalties (dummy)	0.010	Other	0.060
Union density (% members)		Agriculture	0.123
0-9%	0.086	Type of location	
10-59%	0.095	Moscow and St. Petersburg	0.105
60-79%	0.088	Regional capital city	0.360
80-89%	0.087	Other city	0.342
90-99%	0.275	Non-city	0.194
100%	0.369	Legal Environment in region	
Firm fringe benefits		Fraction of cases when managers	0.098
Training	0.647	fail to pay assessed fines on time	(0.085)
Kindergartens	0.433	Fraction of cases where arrears were	0.216
Housing	0.382	paid off after violation was	(0.158)
Training costs (days) /100	82.022	discovered	
	(92.850)		

Notes: Observations=4061, except for quit rate (2611) and legal penalties (3675). Sample consists of industrial and agricultural firms with nonmissing values on wage arrears, union density, and fringe benefits in 1991–1999. Standard deviations are shown in parentheses. The quit rate is ratio of number quitting to average employment.

Table 4: Linear Reaction Function, Nonpublic Sector

	OLS	District FE	Firm FE	Worker FE
Ω (local arrears)	0.894***	0.563***	0.988***	0.839***
	(0.088)	(0.152)	(0.168)	(0.174)
Male	0.358***	0.349***	0.361**	…
	(0.111)	(0.110)	(0.169)	
Schooling (years)	0.002	-0.006	-0.018	-0.064*
	(0.021)	(0.021)	(0.028)	(0.033)
Age (years)	0.001	-0.000	0.010*	…
	(0.003)	(0.003)	(0.006)	
Tenure (years)	0.026***	0.028***	0.020***	0.037***
	(0.005)	(0.005)	(0.006)	(0.011)
Hourly wage rate (rubles)	-0.003**	-0.005***	-0.003	-0.003
	(0.001)	(0.002)	(0.002)	(0.002)
Family income (thous. rubles)	-0.012	-0.027**	-0.009	-0.015
	(0.016)	(0.013)	(0.016)	(0.017)
Employee owns (omitted: No shares)				
<1%	0.252**	0.303***	0.182*	0.343*
	(0.094)	(0.090)	(0.106)	(0.181)
≥1%	0.168	0.164	0.119	0.314
	(0.167)	(0.145)	(0.249)	(0.247)
R^2 (R^2-within for FE estimates)	0.241	0.126	0.112	0.138

Notes: Observations=12306 employee-respondents in the nonpublic sector. Robust standard errors in parentheses are adjusted for clustering within districts; * significant at 10%; ** significant at 5%; *** significant at 1%. The constant term, 9 occupation dummies, 9 industry dummies, 5 year dummies, and 3 dummies for missing values of wages, family income, and employee ownership are included but not shown here.

Table 5: Linear Reaction Function with Instrumental Variables, Nonpublic Sector

	District FE			Firm FE			Individual FE		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
	Second stage results for local arrears								
Ω (local arrears)	0.839***	0.607***	0.583***	1.051***	0.734***	0.741***	1.023***	0.651***	0.654***
	(0.096)	(0.148)	(0.154)	(0.129)	(0.192)	(0.184)	(0.103)	(0.175)	(0.165)
Hansen *J* statistic	3.129	4.072	3.979	3.170	1.212	1.469	4.206	0.732	0.784
Hansen p-value	0.077	0.044	0.137	0.075	0.271	0.480	0.040	0.392	0.676
R^2-within second stage	0.124	0.121	0.121	0.112	0.116	0.116	0.137	0.127	0.127
Observations	12306	8546	8546	12306	8546	8546	12306	8546	8546
	First stage results for excluded instruments								
n_p (local share of public	1.096**	…	…	0.941*	…	…	0.976**	…	…
sector employees)	0.459			(0.529)			(0.486)		
Ω_p (local arrears in	0.659***	…	…	0.664***	…	…	0.659***	…	…
the public sector)	(0.079)			(0.087)			(0.082)		
n_d (local share of defense	…	2.276*	2.253*	…	2.507**	2.489**	…	2.659**	2.632**
sector employees)		(1.214)	(1.241)		(1.202)	(1.223)		(1.150)	(1.172)
Ω_d (local arrears in	…	0.064***	0.065***	…	0.065***	0.065***	…	0.066***	0.066***
the defense sector)		(0.019)	(0.019)		(0.019)	(0.019)		(0.019)	(0.019)
Local share of	…	…	0.426	…	…	0.316	…	…	0.352
pensioners with arrears			(0.331)			(0.334)			(0.334)
Redundancy statistic	…	…	83.367***	…	…	31.982***	…	…	32.909***
F-test of excluded	38.572***	6.761***	5.341***	30.489***	6.910***	5.284***	36.260***	7.770***	5.708***
instruments									
R^2 first stage	0.740	0.701	0.709	0.747	0.712	0.714	0.764	0.717	0.719

Notes: Robust standard errors in parentheses are adjusted for clustering within districts; * significant at 10%; ** significant at 5%; *** significant at 1%. All specifications in Table 5 include the same set of covariates as in Table 4. The redundancy statistic indicates that the district share of pensioners with arrears is not a redundant instrument.

Table 6: Linear Reaction Function, Public and Defense Sectors

	OLS	District FE	Firm FE	Worker FE
Neighborhood effect in the public sector (N=7010)				
Ω (local arrears)	0.404***	0.298***	0.405***	0.469***
	(0.061)	(0.076)	(0.101)	(0.082)
Ω_n (local arrears in the non-public sector)	0.305***	0.270***	0.287***	0.353***
	(0.046)	(0.085)	(0.089)	(0.073)
Neighborhood effect in the defense sector (N=1022)				
Ω (local arrears)	0.132	0.098	0.141	0.132
	(0.232)	(0.291)	(0.352)	(0.411)
Ω_n (local arrears in the non-public sector)	0.212	0.255	0.249	0.279
	(0.154)	(0.226)	(0.274)	(0.336)

Notes: Robust standard errors adjusted for clustering within districts are in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The public sector consists of municipal utilities, public services such as health care, education, and government, and defense industries. The defense sector includes employees in defense manufacturing and army. The equations in this table also include all variables in Table 4.

Table 7: Costs of Wage Arrears, Results from Worker Data

	Desire to Switch Jobs (Probit, dF/dX)	Hours of Work (Tobit)	Quit in Two Years (Probit, dF/dX)
ω (monthly wages overdue)	0.024***	-1.463***	0.009***
	(0.002)	(0.260)	(0.003)
Ω (local arrears)	0.000	-0.741	-0.002
	(0.006)	(0.891)	(0.009)
$\omega^*\Omega$	-0.002***	0.170***	-0.001*
	(0.000)	(0.052)	(0.001)
Male	-0.028***	29.076***	0.060***
	(0.009)	(1.231)	(0.012)
Schooling (years)	0.010***	0.546**	-0.011***
	(0.002)	(0.272)	(0.003)
Age (years)	-0.008***	0.275***	0.002***
	(0.000)	(0.050)	(0.000)
Tenure (years)	-0.008***	-0.300***	-0.007***
	(0.001)	(0.066)	(0.001)
Hourly wage rate (rubles)/10	-0.016***	-7.314***	-0.002
	(0.003)	(0.273)	(0.003)
Family income (thous. rubles)/100	-0.337	-95.093***	0.124
	(0.242)	(30.512)	(0.338)
Employee owns (omitted: No shares)			
<1%	0.006	0.313	-0.042***
	(0.013)	(1.784)	(0.016)
≥1%	-0.085***	19.771***	-0.004
	(0.019)	(2.784)	(0.026)
Observations	18812	18556	9119
LR chi^2 / Wald chi^2	2038.743	7221.371	771.938
Pseudo R^2	0.089	0.036	0.077

Notes: Sample consists of all employee-respondents in the RLMS. Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The constant term, 9 occupation dummies, 9 industry dummies, 52 district dummies, 5 year dummies, and 3 dummies for missing values of wages, family income, and employee ownership are included but not shown here.

Table 8: Costs of Wage Arrears, Results from Firm Data

	Quit Rate (OLS)	Strikes (Probit, dF/dX)	Legal Penalties (Probit, dF/dX)
ω (number of monthly wages	0.010***	0.003***	0.0006**
overdue)	(0.002)	(0.001)	(0.0003)
Ω (local arrears)	-0.001	0.002**	0.0004
	(0.004)	(0.001)	(0.0003)
$\omega^*\Omega$	-0.002**	-0.001***	-0.0001**
	(0.001)	(0.000)	(0.0001)
Union density (100% is omitted)			
0-9%	0.047**	-0.001	…
	(0.023)	(0.003)	
10-59%	0.024**	0.002	…
	(0.012)	(0.004)	
60-79%	-0.009	0.009	…
	(0.011)	(0.006)	
80-89%	-0.000	0.004	…
	(0.011)	(0.004)	
90-100%	0.002	0.000	…
	(0.006)	(0.003)	
Fringe benefits provided by firms (dummies)			
Training	-0.020**	0.004**	…
	(0.008)	(0.002)	
Kindergartens	-0.011	-0.001	…
	(0.007)	(0.002)	
Housing purchase and	-0.009	0.003	…
construction	(0.006)	(0.002)	
Training costs (days) /100	-0.009***	0.002***	…
	(0.003)	(0.001)	
Type of location (Moscow and St. Petersburg are omitted)			
Regional Capital City	0.014	0.009	0.0001
	(0.011)	(0.005)	(0.0008)
Other city	0.026**	0.004	-0.0021**
	(0.011)	(0.005)	(0.0010)
Noncity	-0.028*	-0.004	-0.0016*
	(0.016)	(0.004)	(0.0008)
Legal Environment			
Fraction of cases when managers	…	…	-0.0091**
failed to pay assessed fines on time			(0.0042)
Fraction of cases when arrears were	…	…	-0.0057**
paid off after violation was discovered			(0.0026)
Observations	2611	4061	3984
R^2	0.137	0.241	0.303

Notes: Sample consists of industrial and agricultural firms. Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Intercept and dummies for years, industries, and non-reported training costs are included but not shown here.

Table 9: Hedonic Wage Function, Nonpublic Sector

	OLS	IV	IV District FE	IV Firm FE	IV Worker FE
ω (number of monthly wages overdue)	-0.040***	-0.161***	-0.022	-0.022	-0.032
	(0.008)	(0.052)	(0.033)	(0.022)	(0.023)
Male	0.346***	0.400***	0.367***	0.293***	…
	(0.026)	(0.031)	(0.025)	(0.030)	
Schooling (years)	0.039***	0.034***	0.035***	0.025***	0.250*
	(0.007)	(0.007)	(0.005)	(0.005)	(0.129)
Potential experience (years)	0.019***	0.022***	0.020***	0.025***	0.278**
	(0.003)	(0.003)	(0.002)	(0.003)	(0.131)
Potential experience^2	-0.042***	-0.050***	-0.046***	-0.051***	-0.094***
	(0.006)	(0.007)	(0.004)	(0.006)	(0.017)
Tenure (years)	0.001	0.004*	0.003**	0.007***	0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Log of monthly hours	0.234***	0.213***	0.212***	0.131***	0.079***
	(0.028)	(0.033)	(0.018)	(0.019)	(0.022)
Employee Owns (omitted: No Shares)					
<1%	0.146***	0.175***	0.084***	0.110***	0.073**
	(0.047)	(0.047)	(0.022)	(0.027)	(0.032)
≥1%	0.211***	0.244***	0.226***	0.112***	0.071**
	(0.047)	(0.054)	(0.042)	(0.036)	(0.034)
R^2 (R^2-within)	0.323	0.128	0.234	0.135	0.086

Notes: Observations=11363 employee-respondents in the nonpublic sector with nonmissing values of wage. Dependent variable is log of real monthly contractual wage at the primary job. Robust standard errors in parentheses are adjusted for clustering within districts; * significant at 10%; ** significant at 5%; *** significant at 1%. The constant term, 9 occupation dummies, 9 industry dummies, 5 year dummies, and 3 dummies for missing values of wages, family income, and employee ownership are included but not shown here. First-stage results are not reported but are similar to Table 4.

Table 10: Non-Linear Reaction Function of Wage Arrears, Nonpublic Sector

	OLS	District FE	Firm FE	Worker FE
Ω (local arrears)	-0.249	-0.896**	-0.093	0.043
	(0.402)	(0.423)	(0.361)	(0.292)
Ω^2	0.304**	0.333***	0.235**	0.173**
	(0.122)	(0.115)	(0.103)	(0.084)
Ω^3	-0.019**	-0.020***	-0.014**	-0.010*
	(0.008)	(0.007)	(0.006)	(0.005)
R^2 (R^2-within)	0.249	0.134	0.116	0.142

Notes: Observations=12306 employee-respondents in the nonpublic sector. Robust standard errors in parentheses are adjusted for clustering within districts; * significant at 10%; ** significant at 5%; *** significant at 1%. The equations in this table also include all other variables in Table 4, but the results for these variables are very similar and therefore not shown here.

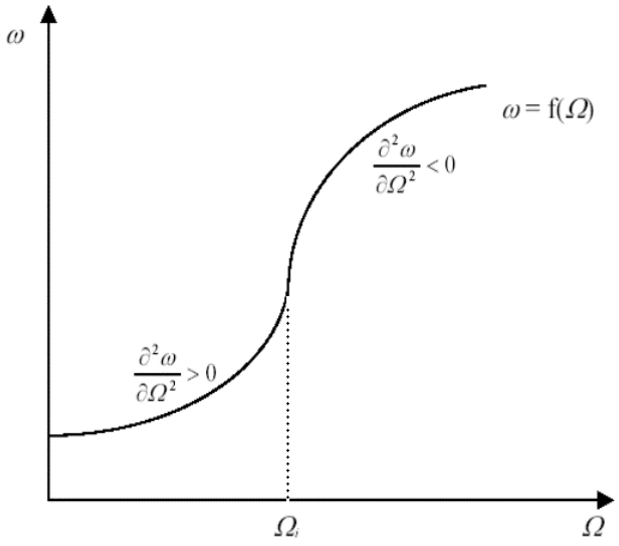

Figure 1: Nonlinear Reaction Function of Wage Arrears

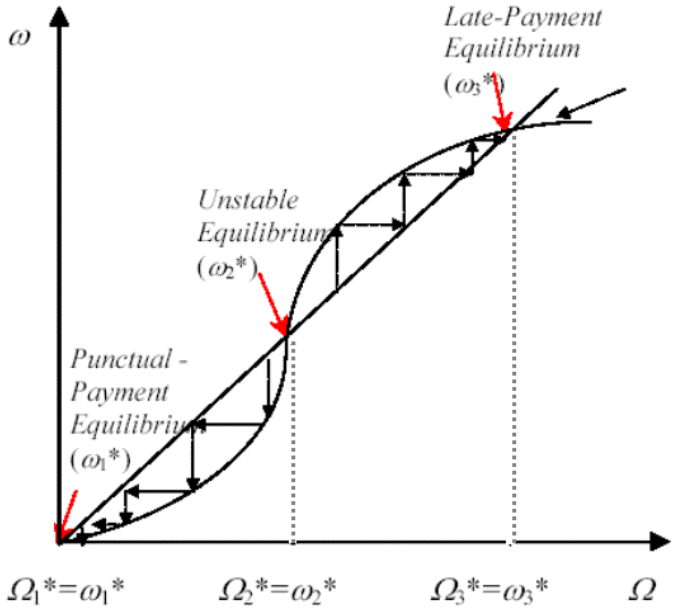

Figure 2: Symmetric Nash Equilibria

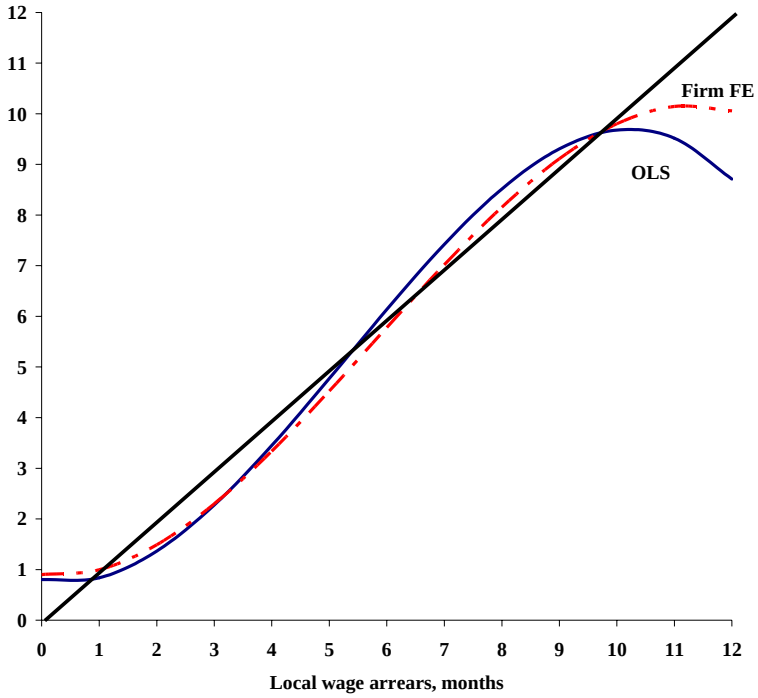

Figure 3: Estimated Nonlinear Reaction Function