

***Stability and Disorder: An Evolutionary Analysis of Russia's  
Virtual Economy***

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# Stability and Disorder: An Evolutionary Analysis of Russia's Virtual Economy\*

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## Abstract

The hybrid system that the Russian transition has evolved into has been called the virtual economy. This paper analyzes the evolution of the virtual economy. We pay particular attention to the interaction of economic reform policies and the adaptive behavior of enterprise directors. We then analyze the implications of the virtual economy for Russia's stability and development, and place the evolution of the virtual economy into the larger international security context.

## 1. Introduction

The transition to the market in Russia is now recognized to be a much more complex process than many people expected. This was recognized by Boris Yeltsin in his latest State of the Federation speech to the Duma:

”We are stuck halfway between a planned, command economy and a normal, market one. And now we have an ugly model – a cross-breed of the two systems.”

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\*Extensive discussions with Bruce Blair, Richard Ericson, Vijay Krishna, and John Steinbrunner have greatly improved this paper.

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The important point is not that Yeltsin mixes his metaphors – spatial and biological. Rather it is that these metaphors are fundamentally incompatible. A hybrid – the biological mixture of two genotypes – is not a halfway point. Were that the case the current Russian dilemma would be simpler to resolve. The purpose of our paper is to show that it is precisely the biological metaphor that provides the key insight to understand the current state of the Russian economy, and to draw the consequences of that insight.

The critical question for Russia’s future development is whether the current situation represents a transitory detour or a fundamental crisis of transition. The successful development of the Russian experiment depends on a successful economic transition. If the current crisis is merely a temporary detour its implications for Russia’s fundamental stability are not too severe. We argue in this paper, however, that Russia’s economic development has evolved into a new system – a *virtual economy* ([11], [12], [13] [8]) – that represents an economic system that is stable in the near term, but one that is not conducive to sustainable economic development.

In order to understand the future development of the economy we must analyze how the economy got stuck. That is the Russian problem, and it is the primary question posed by the Russian experience for the economics of transition. Some argue that the virtual economy is just a continuation of the Soviet economy. This is not quite right; while there are important legacies from the Soviet period, it is important to understand how agents have *adapted* their behavior.

The virtual economy was the result of behavioral adaptation in the wake of incomplete shock therapy. The debate between proponents of shock therapy and of a gradualist approach argue over details, but share a common technical view of the reform problem.<sup>1</sup> That is, the argument is over the pace of reform but not the nature of it. We argue that this technical focus leads to an incomplete understanding of enterprise behavior, resulting in policies that focused too narrowly on economic policy instruments.<sup>2</sup> The narrow approach induced enterprises to adapt their behavior in ways that crystallized into the virtual economy. To analyze this process an evolutionary approach is utilized.

The evolutionary approach enables us to understand the behavioral adaptation that is at the heart of the process. It is also important to understand the larger

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<sup>1</sup>See, for example, the work of [17] and [19].

<sup>2</sup>Political reasons were at least as important. But the misunderstanding of enterprise behavior altered the compromises that reformers were willing to take. There is also an crucial role played by the international security environment. This is discussed below in section 6.

context in which the system developed, for this too will help us understand its likely future. We examine this in the context of the fundamental imperatives that any society must meet, and explain how the virtual economy was the result of the economy's inability to meet all of these imperatives.

## 2. Soviet Roots of the Virtual Economy

The roots of the virtual economy lie in the largely unreformed industrial sector inherited from the Soviet period. At the heart of the phenomenon are the large number of enterprises that still produce goods but destroy value.<sup>3</sup> An enterprise destroys value when the value of inputs purchased from other enterprises exceeds the value of the output that is produced.<sup>4</sup>

To understand the phenomenon of value destruction it is important to begin with Soviet pricing. Raw material inputs were underpriced in the Soviet economy.<sup>5</sup> Their prices were based on the operating costs of extraction, ignoring rent (that is, disregarding the opportunity cost of using the resources now rather than in the future). No doubt this harmonized with the goal of increasing production today; scarcity pricing might have induced more conservation, which mitigates against maximizing current production. This bias in raw material prices fed into the system of industrial prices. Heavy consumers of energy were, in effect, subsidized. So too were heavy users of capital, thanks to the absence of interest charges. In short, costs of production were calculated on the basis of an incomplete enumeration of costs.

In addition to incomplete cost-based pricing, the system was biased towards certain users. The same commodity would carry a different price if it were used by heavy industry or light industry. This would then feed into the calculation

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<sup>3</sup>It is important to note that activities can temporarily appear value destroying because of a decline in demand, as in a strong recession. Our concern here, however, is with activities that have been value destroying for much more than a temporary period. For a fuller analysis of value destruction, see [13].

<sup>4</sup>To assess whether value is created or destroyed market prices are crucial. Notice that the same configuration of activities can produce value at one set of prices and destroy it at others. Thus the Soviet economy separated domestic prices from the world market. Given Soviet prices, which placed a high premium on defense output, economic activity produced value. It is compared with outside opportunities for using the same resources that the phenomenon of value destruction comes into play.

<sup>5</sup>See [7] for a discussion of calculation of national income in the Soviet economy, and on the implications of pricing rules on the measurement of sectoral income.

of costs of production of these goods, so that high priority sectors would appear to have lower costs of production than low priority sectors. This meant that the apparent distribution of productivities at the onset of transition, what we may think are efficient sectors, was liable to mask the true picture.<sup>6</sup>

The fact that the pricing system disguised the relative efficiency of various activities means that only with economic liberalization would the true viability of these activities become apparent. Many sectors that appeared to be creating value turned out to be destroying value once prices moved to reflect costs.<sup>7</sup> The extent to which the Soviet economy produced the "wrong things in the wrong way" could only be gauged after liberalization. This effect was magnified by the move to world prices.<sup>8</sup> Many industrial enterprises could not cover costs once prices moved to market-clearing levels. Raising prices only led to unsold output. Price liberalization revealed the extent to which value added in the Soviet economy was really created in the energy and raw materials sector, but it had the effect of making reform appear to be the destroyer of the manufacturing sector.

The crucial point is that under Soviet pricing it was essentially impossible to discern whether an enterprise was value producing or not. This could only be evaluated once prices moved to clear markets. Hence, revelation of the true nature of the production structure occurs only with liberalization. Recognition of the non-viability of value destroying enterprises is confused by the argument that failed reform policies are the cause.<sup>9</sup> Much of the change in the sectoral distribution of output that has occurred since the end of planning is due more to price liberalization than to real changes in the economy.<sup>10</sup> The Russian economy remains a hyper-industrialized system composed of enterprises that would not be viable in a market economy, supported by transfers from energy and raw materials

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<sup>6</sup>See [7] for an analysis of the implications of arbitrary pricing on the apparent and actual production of value added in the Soviet economy. [6] was the first study to formalize the dual nature of the Soviet economy in terms of priority (military) and nonpriority sectors.

<sup>7</sup>It is perhaps more correct to say that the end-users in the Soviet regime – the Communist Party – placed such a high value on the output of the defense sector the value was produced. The problem is that with the end of the regime that value of that production has shrunk dramatically.

<sup>8</sup>This point was emphasized in [2, 80.]

<sup>9</sup>This is exacerbated by the reform-induced recession common to even successful transition economies.

<sup>10</sup>This becomes apparent when sector output for the Soviet period is measured at world prices. Consider, for example, the contribution to industrial output from electrical energy, fuel, and forestry and timber products. In 1991 at Soviet prices these sectors contributed 17.1% of total output. At world prices, however, these sectors amounted to 51.6% of total output! See [16, chapter 1].

sectors.

There is one other key difference between the Soviet economy and the current Russian economy that should be discussed here. Under Soviet conditions the transfer of value from energy and raw materials to industry was merely an accounting convenience. There was no operational economic implication. Industry appeared more productive than was actually the case, but this was immaterial to the operation of the system. In the Russian economy, on the other hand, the transfer of resources from energy and raw materials to industry must be *induced*. The transfer of value is no longer simply an accounting convenience. It now reflects a redistribution of income. To maintain this the owners of assets that are contributing value must be induced to do so.<sup>11</sup> To the extent that the payment necessary to induce the value transfer leaves the system (e.g., in the form of capital flight), the Russian economy has less total value with which to support government consumption compared with the Soviet economy.

### 3. The Nature of Reforms

The central idea of economic reform is to influence enterprise behavior via the budget constraint.<sup>12</sup> The goal of market reform is to focus attention on the bottom line; to force enterprises to increase revenues or cut costs to satisfy the budget constraint. This is the natural way for economists to view reform. Enterprise behavior is fully characterized by the budget constraint. A profit-maximizing firm will respond to the budget constraint in appropriate ways; either by reducing costs or increasing revenues.

#### 3.1. Budget Constraint

An enterprise can relax the pressure from its budget constraint in several ways. First, it can increase efficiency, raising the amount of output that it can obtain from given inputs. Secondly, it can reduce the amount of inputs purchased, although this may also reduce revenue if these are needed for production. Third, the enterprise may increase sales through better marketing, obtaining a better

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<sup>11</sup>This relates to the notion of "good leakage" discussed in [11].

<sup>12</sup>A related aspect of this was the following bargain: become transparent and the cost of borrowing will be reduced. Because credit is more likely to flow to enterprises which have more transparent books, and because firms in transition suffer from credit constraints, there should be great incentive to clean up the books to attract credit. Of course, this only works if credit is actually available, as we discuss below.

price for output. The enterprise can also forego investment. If capital depreciates, however, this has long-run consequences for production, since the capital stock in period  $t + 1$  will be lower than in period  $t$ .<sup>13</sup> The enterprise can also borrow, if credit is available. Thus if the enterprise can transform itself to make it more attractive to investors it is able to relax its budget constraint. Notice that borrowing today implies that repayments will be higher in future periods.

The budget constraint is hardened by reducing subsidies or increasing tax payments. In Soviet times subsidies were a central feature of a regime that required production of goods independent of cost considerations.<sup>14</sup> In transition, most explicit subsidies have been reduced, though implicit subsidies often remain, and tax offsets and other special deals are a key feature of the environment. What is crucial at present, however, is that one can easily conceptualize how a hardening of the budget constraint – via elimination of direct and indirect subsidies and through collecting taxes – forces the enterprise to meet the budget constraint through market methods.

### 3.1.1. Market Distance

Reform via the budget constraint is premised on the assumption that the only dimension for survival is profits. If enterprises cannot earn profits they cannot survive. Hence, tightening the budget constraint would force enterprises to increase efficiency. Of course, this weakens all enterprises at impact before adjustment. But the idea is that the stronger will survive and get stronger.<sup>15</sup>

The underlying notion here is *monotonicity* of reform. This means that the effects of the shock on an enterprise depend on the degree of inefficiency. We can think of enterprises in terms of the distance they must traverse to produce a marketable product.<sup>16</sup> Let  $d_i \in (0, D)$  be the distance of enterprise  $i$ . An enterprise that produces a product it can sell in world markets has  $d_i = 0$ , while a completely inefficient enterprise has  $d_i = D$ . Transition starts with some initial

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<sup>13</sup>This is clearly a popular strategy employed by many Russian enterprises.

<sup>14</sup>The soft-budget constraint of a Soviet-type enterprise [15] involved *ex post* subsidies. In transition, soft-budget constraints are often transformed into tax arrears and arrears to other enterprises.

<sup>15</sup>The image suggested is that of a vaccine, which introduces minute amounts of a virus in order to trigger the immune system to produce antibodies. The rationale for hardening budget constraints represents an attempt to stress the organism to induce it to restructure its behavior to increase long-run viability.

<sup>16</sup>The notion of market distance is discussed at length in [10].

distribution of enterprise distance.<sup>17</sup> The greater is  $d$  the less viable the enterprise. Suppose that  $\underline{d}$  is the cutoff point for viability: that is, all enterprises with  $d_i > \underline{d}$  are not financially viable.

Now consider the effect, for example, of an increase in tax collection. This tightens the budget constraint for all enterprises, essentially increasing  $d_i$  for all  $i$ . Those enterprises that were closest to the breakeven point,  $\underline{d}$ , are pushed beyond it. The pressure to restructure is greatest for enterprises closest to this point, but all feel the pressure. The more inefficient, the greater the shock. The most inefficient may be wiped out by the shock, but healthier enterprises will grow stronger as a result of the intervention.

This uni-dimensional view of restructuring – reform means reducing  $d_i$  – lies at the heart of much reform advice.

### 3.1.2. Relational Capital

Now suppose that the organism has another survival mechanism. Enterprises also differ in their inherited stock of relational capital. Some enterprises (directors) have very good relations with local and/or federal officials. Relations with other enterprises (directors) will also vary. The stock of these relationships determines the types of transactions that can be supported (barter versus cash, pre-payment, etc.). Relational capital is goodwill that can be translated into informal economic activity.<sup>18</sup>

Let  $r_i$  be the stock of relational capital of enterprise  $i$ . The actions that an enterprise takes can affect its stock of  $r_i$ . Just as investment augments the physical capital stock, enterprises can invest in relational capital as well. An enterprise can, for example, perform services for the local government. This action may enhance the enterprise's relationships with local officials, and thus increase its capacity to conduct informal activities in the future. It is important to recognize that augmenting relational capital is costly.

The key point is that relational capital can aid enterprise survival. Enterprises that have high  $d$  may survive by exploiting relational capital,  $r_i$ .

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<sup>17</sup>Let  $\mu_i$  be  $i$ 's share of GDP (or employment), then  $\Omega = \int_i (d_i \mu_i) di$  is a measure of the average distance of the economy. It thus represents the initial level of the gap that must be overcome in transition. An important point about Russian initial conditions is that  $\Omega$  was larger than in other transition economies.

<sup>18</sup>It is important to note that relations aid in production. Hence, investing in relations is *not* the same activity as rent-seeking.



### 3.2. R-D Space

Consideration of relational capital informs that the initial conditions that characterize enterprises in transition are two-dimensional. We can illustrate this with figure 3.2 (taken from [10]) which we refer to as the *R-D* space diagram.

Although relations can allow an enterprise to compensate for large distance, some enterprises have such poor initial combinations of  $r$  and  $d$  that they are unviable. Not only are these enterprises situated far from the market, but the quality of their relations with officials and other enterprises is so poor that they cannot be relied on for survival. Clearly, the minimum level of relations needed to survive is increasing with distance. So we can imagine a boundary ( $VC$  in figure 3.2) with positive slope that separates the region of viable enterprises from those that are not viable.<sup>19</sup> It is clear that the larger the distance to the market, the greater is the minimum level of relations necessary to survival. This implies the positive slope of the  $VC$  line. How steep  $VC$  will be depends on the institutional setting.<sup>20</sup> In a fully transparent economy relations may compensate very little for large distance. If officials are more corrupt, then relations may be much more important.

In this two-dimensional environment, the effects of market-type reforms need not be monotonic. That is, tightening of the budget constraint does not necessarily put the most pressure on those enterprises that are most inefficient (have the highest  $d$ ). Those that invested in  $r$  are relatively better off. If investment resources are limited then the relevant issue for an enterprise is the relative return to investing in distance reduction and relational capital.<sup>21</sup> What is critical for our analysis is that these relative returns will depend on the nature of reforms and on the choices of enterprises.

### 3.3. Privatization of Relational Capital

One of the most important, but rarely emphasized, results of economic reform in Russia was the privatization of relational capital. In Soviet times, personal relations, connections, and influence (*blat*),<sup>22</sup> had important value to the functioning

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<sup>19</sup>Notice that the position of the  $VC$  line will depend on how open is the economy. Enterprises that would be unviable (for given  $d$ ) in an open economy may be viable if the economy is autarkic.

<sup>20</sup>As  $d$  increases, we may further suppose that the minimum  $r$  necessary to survival increases at an increasing rate.

<sup>21</sup>The analysis of enterprise decisions to reduce distance and invest in relations is analyzed in [10].

<sup>22</sup>See [18].

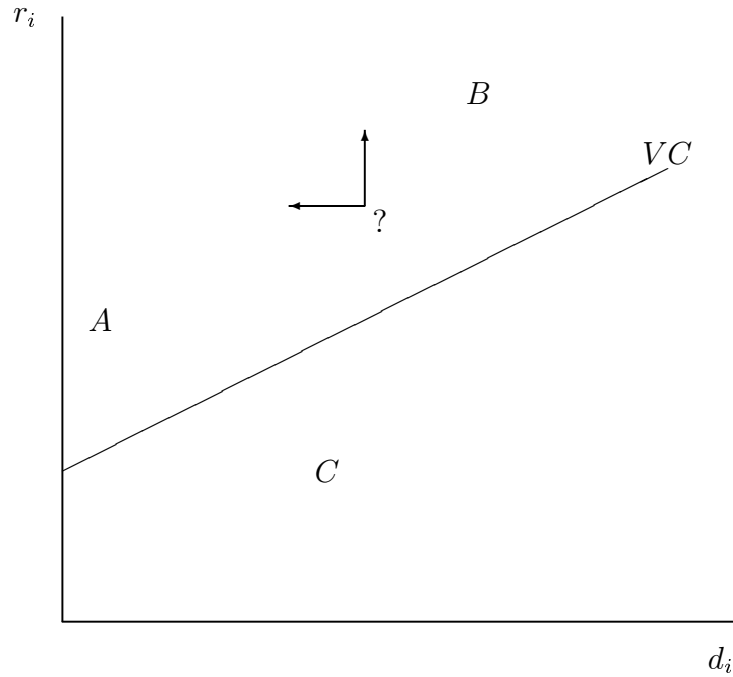


Figure 3.1: R-D Space

of the system. The primary benefit to the director lay in increased ability to fulfill the plan. In the highly distorted regime of central planning supply failures were a constant feature of economic life. Relations with local party officials and with other enterprise directors were often crucial to obtaining scarce inputs. In late *perestroika* and even more during economic reform the autonomy of the director increased as the force of the plan weakened. One consequence of this was that directors obtained the capability to appropriate the returns to the relationships they had developed.

It is important to note that for directors to appropriate these returns it is critical that enterprises continue to operate. Much of this capital was enterprise

specific. The primary form of these connections is in relationships with directors of other enterprises, often in related lines of activity. The director cannot cash this out. Instead, to appropriate these rents it is crucial to keep the enterprise operating.

To appropriate these rents the director utilizes relationships to obtain inputs and find customers. If the enterprise produced marketable products these relationships would be of less importance. Hence, workers would be less content to see a portion of the income of the enterprise diverted by directors. But for an unviable enterprise the alternative to director appropriation is enterprise closure. Faced with this tradeoff, workers are more willing to accept the personal enrichment of a director who is also able to obtain resources necessary to keep the operation going.

The privatization of relational capital is thus an important part of the explanation of why directors fight to keep open enterprises that have few prospects in the market economy. Notice the symbiotic relationship between the workers and directors. Workers need the director to keep the unviable enterprise afloat. Directors need the enterprise in order to exploit their relational capital.

#### **4. Mutation and Resistance: An Evolutionary Analysis**

Enterprises, and enterprise directors, exploiting relational capital to survive in a more hostile environment can be thought of as a mutation. This view fundamentally contradicts that of reformers who designed the Russian privatization. They viewed Soviet-type enterprises as typical enterprises encumbered by political controls. The notion was that without government control, and with hard budget constraints, enterprises in Russia would behave like "normal" enterprises.<sup>23</sup> That is, once political controls were lifted they would maximize shareholder value like any firm in the west.

This conventional view ignores the fact that due to the mutation of the enterprise it has survival strategies unavailable to the "normal" enterprise. The enterprise in the virtual economy can produce goods that can be used for barter or for tax offsets but that cannot be sold on the market. It can also procure inputs at a lower cost because relations allow it to pay in non-monetary means.

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<sup>23</sup>This was articulated clearly by some key architects of Russian privatization. For example: "In our view, controlling managers is not nearly as important as controlling politicians, since managers' interests are generally much closer to economic efficiency than those of the politicians" [3, 65].

The cost of acquiring these extra strategies is lack of transparency, which makes it impossible to attract external funds for restructuring. Hence, the enterprise in the virtual economy finds it prohibitive to reduce distance, while the market-oriented enterprise cannot engage in virtual survival strategies.<sup>24</sup>

This incomplete shock produced a sudden change in the environment facing enterprises. The importance of the mutation is that now the effects of the environment shift were not monotonic. Enterprises that chose transparency would be at a competitive disadvantage to those that invested in, or had initially high, relational capital. Shock therapy is supposed to impact on enterprises via the effect on the budget constraint. Hence, those enterprises that had invested in alternative means of survival would be less effected by the shock. These enterprises are "effectively" immune from the therapy, even if the therapy was designed precisely to attack them.

Notice that the proportion of enterprises that follow the virtual strategy is not limited by the frequency of mutation. Enterprises can *imitate* behavior that they observe to be successful. If some enterprises in the virtual economy are able to survive without undertaking costly restructuring, then other enterprises may choose to follow this behavior. Hence, once virtual strategies appear to be working the system may rapidly tip.<sup>25</sup>

This is not necessarily an argument that reforms were ill-conceived,<sup>26</sup> though excessive focus on the budget constraint may suggest that it was. It also refers to *implementation*. Reforms that would have shut down lossmaking enterprises were shunned because the consequences of these reforms were deemed intolerable.<sup>27</sup> Clearly, effective hardening of budget constraints was an implicit assumption necessary to the therapy of tight money and liberalization. The fact that hard-budget constraints were avoided through investment in relational capital means that reforms were not fully implemented.

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<sup>24</sup>In practice the boundary is rarely so sharp. See [10] for a discussion of *Igor's* rules for successful enterprise management in Russia.

<sup>25</sup>In the appendix we provide an example of an evolutionary game where such tipping can occur. Starting from an economy populated only by Soviet enterprises, the evolution to the market can detour to the virtual economy if enough Soviet-type enterprises survive.

<sup>26</sup>That argument has been made quite often, recently, most notably in [19].

<sup>27</sup>This argument is developed further in [13] using the concept of "impermissibility."

#### 4.1. Incomplete Therapy

Incomplete shock therapy failed to wipe out loss-making enterprises. A new mutant strain emerged with the survival strategies available in the virtual economy. This made it harder for new enterprises to compete. The greater the number of mutant enterprises that exploit these virtual strategies the greater the relative disadvantage for market-type enterprises, because mutant enterprises operate under different rules.

The process we are examining bears a relationship to the problem of multi-drug resistant (MDR) tuberculosis (TB). MDR strains of TB are never found in the wild. Genetic resistance to particular drugs occurs naturally, but this is diluted by the overwhelming prevalence of drug-susceptible organisms. In the natural environment there is no evolutionary advantage to genetic resistance to antimicrobials which are introduced by man. The presence of antimicrobials provides the selective pressure for resistant organisms to become predominant. Human intervention that introduces antimicrobials creates the selective pressure in favor of MDR. The primary mechanism by which this happens is an *incomplete* regimen of treatment (or poor adherence to a proper regimen). The incomplete regimen wipes out the drug-susceptible organisms, leaving the field for the drug-resistant varieties.

The analogy with enterprise behavior is straightforward. In a competitive environment there is no selective advantage to investing in relational capital. Reducing market distance is the key to viability. Incomplete therapy in Russia, however, did not create such an environment. Relational capital continued to result in a positive payoff in terms of enterprise fitness and survival. For enterprises that possessed sufficient relational capital, the opportunity to survive via virtual strategies became a viable option. Hence, the burden of therapy was on the enterprises that did not have, or chose not to invest in, relational capital. Incomplete therapy imposed a *relative* burden on enterprises that chose to act in a "normal" manner. Hence, incompleteness provided selective pressure that favors the mutant enterprise. This is similar to the outcome for a TB patient who does not take the full complement of anti-TB drugs, or who fails to follow a multi-drug regimen.<sup>28</sup>

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<sup>28</sup>In fighting TB it is crucial to follow a multi-drug regimen, because the virus mutates sufficiently so that a unitary drug regimen is ineffective. See, for example,

## 4.2. Behavioral Adaptation

In the biological world evolution relies solely on relative fitness. In social evolution, however, adaptation can occur not just through replication but through adaptation.<sup>29</sup> Enterprise directors can observe the success of other enterprises and adapt their behavior. This could lead to more rapid adjustment to the virtual equilibrium.

In the previous example it was assumed that enterprises were equally likely to interact with any type of enterprise. Payoffs were determined solely on the basis of population frequencies for the economy as a whole. This seems to be the logical assumption because the nature of the payoffs depends on the mixture of enterprises in the economy, not on particular interactions.

One could argue, however, that enterprises may be more likely to interact with like-minded enterprises. This could lead to further bifurcation. If agents tend to interact with like-minded agents, this may reinforce behavior.<sup>30</sup> Recall that the payoff to being a virtual enterprise increases is higher when interacting with other virtual enterprises. This suggests that the virtual trap could be strengthened by the presence of non-random interactions.

Evolution can also occur via cultural transmission. Most models in evolutionary game theory assume that agents interact randomly with other agents. But in structured environments, agents interact more often with agents that are similar to them. This can speed the adoption of certain equilibria. This is certainly relevant for transition economies, because enterprises in the production sector tend to interact with the same enterprises that they dealt with under central planning. The increased interaction with such a structured group can lead to a more rapid adjustment to the new equilibrium.

## 4.3. Policy Ineffectiveness

Notice that all of the shocks that have occurred since the start of transition have had greater relative impact on marketized enterprises. Attempts to increase the intensity of reform have all focused on hardening the budget constraint without any actions to reduce the payoff to investments in relations. Such policy measures illustrate the principle that in the virtual economy populated by mutant

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<sup>29</sup>This has been studied in different contexts by [4] and [20].

<sup>30</sup>For example, [20] has shown that if agents interact in sufficiently small, close-knit groups, then the expected waiting time until the evolutionary process comes close to its asymptotic distribution is bounded independently of the number of agents or of the initial state.

enterprises, conventional policy prescriptions will not work as expected. Here we consider two examples.

#### 4.3.1. Transparency

The first illustrative example of a policy that has unintended consequences is increasing enterprise *transparency*. An essential element of market reform is that enterprises make their financial activities more transparent. The implicit bargain of market reform was that greater transparency would be rewarded by greater access to credit. Financial markets require transparency, as does foreign investment. Of course, transparency also makes problems more apparent. But if the only way to obtain external financing is to take the plunge to greater transparency, then enterprises will choose this costly option.

The problem with choosing transparency is two-fold. First, it precludes the use of strategies that rely on relational capital. Second, transparency is essentially irreversible. If there were no  $r$  then those enterprises with greater  $d$  would be disadvantaged. The move to greater transparency would have the greatest benefits for enterprises that are closest to the market. Hence, the fitness of the most efficient enterprises would be enhanced relative to lossmaking enterprises. The problem is that when relational capital is an available survival strategy those enterprises that chose transparency may be relatively *disadvantaged*.

This argument has important implications for discussions of the role of corporate governance. It has become almost commonplace to point out that inadequate corporate governance is a severe problem in Russia, one that inhibits investment, especially foreign investment.<sup>31</sup> The conventional view is that weak corporate governance is a key barrier to external finance for Russian enterprises. This is an important argument, but it is critical to keep in mind that the opposite is also true: the low probability of attracting external finance inhibits the development of good corporate governance. There are two parts to this. First, enterprises that have very high  $d$  see very little return to improving corporate governance. Even with very transparent relations they are unlikely to attract external financing, because the expected return is so low. Second, enterprises that may have higher expected returns face the twin problems of high interest rates and increased tax incidence. The fiscal problems of the Russian government increase the cost of external finance. This automatically reduces the expected return. In addition to

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<sup>31</sup>See, for example, [1, 176-181] for a discussion of the problems of corporate governance on the prospects of attracting investment. This issue has recently been taken up by Stiglitz [19].

this, an enterprise that chooses to reduce  $d$  faces increased relative tax incidence from entering the monetized part of the economy. This also reduces expected return. Hence, enterprises led by directors that fully understand the connection between good corporate governance and external finance may *choose* not to implement the former because the benefits are not sufficient.

The relative disadvantage faced by enterprises that chose transparency is the product of extremely high costs of external finance. Ignoring problems of corporate governance – these should be less severe in transparent enterprises – the fiscal policy of the Russian government has crowded out much investment. Transparent enterprises have not received the intended benefit, but they have paid the cost in terms of foreclosing the use of relational strategies. Those enterprises that chose transparency are now more vulnerable than before.

This effect is especially true when there is a tax crackdown. High tax rates that result from fiscal weakness and campaigns to increase tax collections mean that pressure falls greatest on those enterprises whose books are most transparent.

#### **4.3.2. Tight money**

A second example of a policy that is rendered ineffective by the virtual economy is that of tight money. An essential element of shock therapy is a policy of tight money to stabilize the price level. Indeed, most critics of so-called shock therapy have pointed to tight monetary policies as one of the prime causes of the output fall. Certainly, tight money is an essential element of the tightening of budget constraints. If credit is lax there is less pressure on enterprises to restructure.

Tighter credit is a perfect example of a policy that is supposed to hurt all enterprises, but in fact has the greatest impact on the least efficient. The policy of tight money is premised on the assumption that reform is monotonic. If survival via investment in relational capital is feasible, then this assumption is not appropriate. Enterprises that invest in relational capital may insulate themselves against credit shocks. Tight money then has greater relative impact on those enterprises that invested in reducing distance. The "fitness" of the latter enterprises is reduced relatively by the tight money policy. This induces imitation, and virtual behavior spreads.

Enterprises in Russia were able to use relational capital to insulate them from the stringencies of the budget constraint. The ability to pay for inputs and to pay taxes in kind, rather than in cash, provides them with an advantage compared to those that must use cash. Barter typically costs the paying enterprise less than



an equivalent *nominal* amount of cash. Else, the enterprise would sell the output for money and pay with it.<sup>32</sup> Hence, once barter became more common even enterprises that could afford to pay with money chose to use barter.

We can put this in the context of our evolutionary analysis. The transition process was perturbed by the tightening of credit during 1995 and the ruble corridor. This induced a mutation in enterprise behavior. In particular, monetary tightening induced the use of barter. Lack of liquidity may have induced enterprises to engage in non-monetary behavior. Once this mutation occurred, the stability of virtual behavior implies that barter would persist even if the initial conditions that shocked the system are no longer present.

This account fits with some recent empirical work that studies barter. It has been argued by [5], for example, that barter became widespread in Russia in response to the monetary tightening of 1994-1995. Yet, as demonstrated in [14], barter does not seem to be related to the financial position of the enterprise. The latter study also shows that there is a lock-in effect of barter: once enterprises use barter it is cheaper to continue. We return to this below 4.3.2.

The key point is that the importance of relational capital and of networks of relationships among enterprises preceded the imposition of tight money. Hence, when tight money was imposed, resort to virtual strategies caused the policy to be ineffective. Tight money penalized the wrong enterprises. It reinforced barter – a phenomenon that clearly preceded the tightening of credit – and provided a relative advantage to those whose relations were sufficient to support barter. This leaves the interesting counterfactual: if tight money would have been imposed earlier – *before the mutation* – would it have been more effective because virtual behavior was not consolidated yet?

## 5. Implications for the Future

What are the implications of our analysis for the future evolution of the Russian economy? Is the virtual economy a stable institutional setting? Or is it a temporary resting point which will soon become a historical curiosity?

The argument in favor of the historical curiosity position rests on the notion that the virtual economy cannot sustain itself over the long run. There are several

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<sup>32</sup>This is not quite correct. There are other costs of using cash. It may attract criminal groups if it is known that the enterprise possesses cash. There may also be tax advantages of using barter. In addition, an enterprise that signals that it has cash may find it harder to delay wage payments to workers. For further discussion, see [10].

aspects to this argument. First, one key part of the virtual economy—the manufacturing sector—is made up of old capital and old labor. One expects that over time these factors will wear out. Capital replacement in loss-making enterprises is nearly non-existent. This suggests, perhaps, that over time the size of this sector will shrink relative to the rest of the economy.

A second approach is to consider the question from the infusion of value. We know that the operation of the virtual economy depends on the continued infusion of value; most importantly, from *Gazprom*, but also from the new private sector and external sources. One could argue that in principle there are no serious limits to further infusion of value. As long as actors are willing to support the system this peculiar institution can persist. The capacity of the system to tap value is not unlimited, however. First, the gas and oil sector—the most important source of value in the economy—has suffered from inadequate investment. Analysts suggest that this will severely hamper production in the future. In a sense, the current operation of these sectors overstates true value production.<sup>33</sup> Inadequate investment means that current levels of value creation cannot be maintained indefinitely.

A second limitation regards external sources. In the wake of the August 1998 crisis and the default on short-term government debt (GKO), foreign investors have been less willing to invest in the Russian economy. It is not clear how long the aftereffects of this shock will linger. But the optimistic scenarios that led to foreign investment have been shattered. Moreover, the international financial institutions appear more reluctant to increase aid levels above what is needed to keep Russia quasi-current on debt repayment. (We use the term "quasi-current" because the debt is being re-scheduled; the purpose is to keep this an orderly process.)

The third source of value is Russia's domestic private sector. Once again, however, the capacity of this sector to provide value to offset loss-making elsewhere is limited. The very operation of the virtual economy is a heavy tax on new activity.

Whatever the levels of infusion of new value, the virtual economy still redistributes that value in an inefficient manner, since value is lost in the process. First, value is destroyed in production by an uncompetitive manufacturing sector. Second, value is leaked from the system. Some is the necessary leakage to keep value-adders in the system (the "good leakage"); other is unnecessary, a form of looting;. Third, barter—the characteristic form of exchange in the virtual

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<sup>33</sup>For an analysis of *Gazprom*, for example, see the report by *Deutsche Bank*, "Gazprom: Show Me the Money," September 29, 1999.

economy—by its very nature involves substantial transactions costs.

In short, the picture is one of waning sources of value to be pumped in, continued loss of value inside the system, and leakage of value to the outside. Clearly, there is some margin for adjustment in all of these. Slowing the loss of value, on the one hand, and increasing the infusion, on the other, could allow for greater sustainability of the virtual economy. But let us assume that the present trend of at a least gradual decline in available value prevails and ask the question, What happens as the system runs out of value?

### 5.1. The Primitivization of Production: Shrinkage

How the economy adapts to a reduction in the total amount of value to be circulated is the key question for understanding the evolution of the economy. The optimistic scenario has enterprises choosing to restructure in order to survive. With resources no longer infused into the system from *Gazprom* and other sources, enterprises must survive on their own, and hence restructure. This presupposes, however, that the investment decisions – or rather the lack thereof – of the last 8 years can easily be undone. It presumes that the distance that must be traversed to reach the market has *not* increased during the period of postponed restructuring. This assumption is, of course, unwarranted.

What happens to enterprises when the value pump ceases to flow? One possibility is bankruptcy. Enterprises may simply cease production. This is rather unlikely, however, in the case of Russia. Rather than cease production, Russian enterprises on the verge of bankruptcy may transform by contracting their activities, a process we call *shrinkage*. This transformation involves a radical re-orientation of their activities. It may involve complete alteration of production lines. This is not the primary characteristic, however. Rather, the key characteristic of the shrinking enterprise is increasing withdrawal from the market—both in its conventional (monetized) and virtual economy (demonetized) versions.<sup>34</sup>

An enterprise that has seen the value of its relational capital dissipated will cease production of non-marketable, value-destroying goods (ones that consume more in the value of their inputs than they produce). At the same time, given that its distance to the market has increased during transition, the opportunity to shift to producing marketable products is practically non-existent. With a sufficient infusion of external finance, presumably any enterprise can be restructured sufficiently to produce marketable goods. But enterprises that have migrated to-

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<sup>34</sup>For a further analysis of the concept of shrinkage, see [13, chapter 7].

ward the southeast corner of  $r-d$  space are the least likely to be able to attract any external funds, let alone a sufficiently large amount. The alternative for the enterprise is to survive by radically insulating itself from market forces. It will employ its capital stock to produce goods that use little or no purchased inputs. The enterprise focuses its activity increasingly on the pure survival of its workers.

The primary form that this survival focus takes is more small scale production, less specialization, and simply more primitive production. Ironically, it is in a purely technical sense more efficient than the previous situation. Before, the plant was attempting to produce, on as large a scale as it could, a good that, in fact, destroyed value. The more of the good that was produced, the worse the result for the economy as a whole. Now, because the plant uses little or none of the valuable inputs which it previously did, its activity is less socially harmful. Indeed, the enterprise may now be even adding value. But it is doing so on a drastically reduced scale of production.<sup>35</sup>

This transformation of the enterprise via shrinkage is rational, and it is efficient. Less value is destroyed in the new activity. However, there is another side to this development that is less propitious for the country's economy. Shrinkage may also involve a write-off of human capital, and that does represent a waste to society; a permanent loss to the economy from the desperate struggle to survive the loss of relational capital.

## 6. Stability and Disorder

An ironic aspect of Russia's virtual economy is that it is essentially a mechanism that conserves old structures and relationships, yet it is ultimately quite destructive to the society. The virtual economy is a system that operates to prevent changes that need to take place for economic performance to improve. It postpones the day of reckoning for enterprises and institutions that were supposed to leave the scene at the onset of transition.

### 6.1. Implications of the Virtual Economy's Stability

The implications for Russia's economy if it continues along this track are dire. We can see this by examining four important issues for the future: (1) economic

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<sup>35</sup>This may seem like an abstract discussion, but [13, chapter 7] provides a detailed example of just such an enterprise: *Kvarts*, a former TV producer in *Omsk* oblast.

growth; (2) development of the private sector; (3) the national integrity of the economy; and (4) the ability of the public sector to fulfill its tasks and obligations.

### **6.1.1. Economic Growth**

In the virtual economy, official growth figures mean little. Virtual, or illusory, prices result in illusory GDP. The economy may appear to grow, but does not really. It actually contracts. For the short term and middle term, this system is likely to remain stable. But the stability comes with a big hidden cost, since the virtual economy undermines the future competitiveness of the economy. It does not modernize either its physical or human capital. Indeed, the virtual economy acts as a barrier to restructuring.<sup>36</sup> This means that the economy continues to grind down. The further it goes, the less competitive it is.

### **6.1.2. The Private Sector**

The fate of the true private sector – the value-adders outside the virtual economy, including foreign joint ventures – is a vital issue for Russia’s future. The virtual economy has a curious relationship to the private sector. It will not eliminate it, since it needs a private sector in order to survive itself. It needs cash. And it needs the private sector as a social safety valve, for both consumers and workers. But in general, the dominance of the virtual economy is incompatible with a genuinely independent, prosperous private sector. Consequently, small businesses will be permitted to exist. But they will be constrained in the market, not allowed to supply to public sector customers. They will not be allowed to develop as subcontractors for the large enterprises. More seriously, as value-adders producing for the market (i.e., selling for cash), they will be subject to a heavy tax burden. The virtual economy will therefore squeeze the private sector to get the cash it needs (taxes), and it will constrain the private sector to protect the market it needs.

### **6.1.3. National Integrity**

The virtual economy has a natural tendency to fragment the national economy into smaller, self-contained local economies. This trend is evident in Russia. Local

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<sup>36</sup>See [9] for an analysis of the virtual economy trap. In that model, enterprises that have positive expected returns from restructuring choose not to do so because the costs of leaving the virtual economy outweigh the benefits, though positive, of restructuring.

government budgets are already more "virtualized" – demonetized – than even the federal budget. Local governments protect the local market for the benefit of their local virtual economies. In the post-August crisis, regional and local governments intensified the tendency towards localism by introducing measures to hoard goods locally and ban exports, especially of food, even to other regions of Russia.

#### **6.1.4. The Public Sector**

The public sector will be smaller and more demonetized and, as stated above, more localized. The federal government budget is key. Look at the recent record. In 1997, Russia's federal government collected less than 60% of its taxes in monetary form. Its cash tax revenues came to barely \$23 billion at 1997 exchange rates. Even if we add to that its other sources of monetary revenues – privatization sales, customs duties – the government was able to raise no more than about \$40 billion. (That is, this is what it raised on its own, not counting the borrowing at home and abroad.) With a highly-publicized tax collection campaign at the beginning of 1998, the government was slightly more successful in raising cash for a while. But as the virtual economy model predicted, the extra cash to the budget came at the expense of the rest of the economy and helped precipitate the August 17 financial collapse.

Since the default, tax collection in real terms has been below 1997 levels. Moreover, the devaluation of the ruble against the dollar puts the government in a much worse situation as regards foreign debt repayment. The debt burden has become even heavier. As a result, the government has fewer resources at its disposal, and it will continue to fall far short of providing the basic public services for which it is responsible.

Failure to adequately fund government agencies at all levels has meant that these agencies are becoming the bureaucratic analogues of self-subsistence farms. Government employees use government assets (real estate, etc.) and government time to earn enough to keep themselves alive. Little or nothing is left to serve the public. A large amount of their time is spent not on providing public goods at all, not even inefficiently. It is spent on earning money, or growing food, and so on, to finance sheer survival. In the case of some civil servants, whose jobs serve no useful purpose, this may be acceptable. For many others, it is damaging, both for their own health and well-being and for the citizens they are supposed to serve. And for some critical categories – the military is the best example – it may be disastrous.

## 6.2. Time is the Enemy

The virtual economy had become consolidated by perhaps as early as 1994. It might be argued, however, that reform delayed is not reform denied. Adaptation of enterprises to the virtual economy does not mean that they cannot eventually restructure. Improvements in the economic environment can alter the relative payoffs of market and virtual strategies; this could lead to real economic restructuring. Such an improvement in the economic environment could occur, for example, if the tax system is improved, or if the ruble depreciates in real terms.

The notion that delay is not denial has merit but it ignores the fact that delayed restructuring has important consequences. Foremost among these is that the distance that enterprises must traverse increases with time. The initial  $d_i$  that enterprises begin the transition with is relative to the world standard. If the world standard is advancing then an enterprise that simply maintains the current level of efficiency will see its distance *increase*. Hence, the payoff to that enterprise from investing to reduce distance will decline over time. Delayed restructuring increases the margin that must be overcome for an enterprise to become competitive.<sup>37</sup> This raises the relative payoff to engaging in virtual strategies. Hence, stagnation may make the virtual economy more stable.

We can outline four reasons for this bleak conclusion that time has been, and remains, the enemy of reform in Russia:

1. First and foremost, the critical implication of the adaptation of behavior is that the system to be reformed is not the same as it was in 1991-92. The Russian economic system has evolved and adapted as a form of institutionalized protection from and resistance to market reform. Over time, increasingly larger parts of the economy have been drawn into these institutions. The resistance to reform is thus more robust than ever. As a result, today, any program of radical and comprehensive economic reform has almost no popular appeal at all. The prospects are years of pain and dislocation with few, if any, compensating benefits to the population except in the rather distant future. (This contrasts to 1991-1992, when the new reforms granted a great deal of personal freedom to individuals, not just political freedom but economic freedom.)
2. Second, the consolidation of the virtual economy has had an adverse effect on the young generation. Contrary to hopes, young people, in order to survive

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<sup>37</sup>It is as if the  $VC$  line in figure 3.2 is shifting up over time.

and succeed in this system, develop behavior appropriate not to a market economy but to the virtual economy. While some in the new generation appeared to have broken out of old habits, they were still a minority. Most have not. The young generation is not an automatic guarantor of change.

3. Third, even in the hypothetical situation that there were a willingness on the part of enterprises to change and adapt and become competitive in the market, this has become a greater technical challenge than it was six or seven years ago. Things were bad enough then. Even by official Soviet standards, a huge proportion of equipment in Russian industry was physically obsolete when reform began in 1992. The Russian economy needed massive modernization. It has not had it. As a result, a physical plant that was generally old and noncompetitive to begin with is now seven years older and even less competitive. Less drastic, but still important, has been the loss of human capital. The people who worked in those non-competitive industries who felt that they had a chance in the new market economy left and tried their chances there. The people who have remained behind tend to be the least productive.
4. Finally, there is a steadily worsening macroeconomic barrier to successful modernization of the Russian economy: the country's permanent debt trap. Russia continues to build its debt up, not down. This is true not only of the financial debt. It also applies to society's cumulative unpaid nonpecuniary costs especially damage to the environment and the undermining of public health. These are costs that have to be paid some time, somehow. They cannot be erased by a default.

To sum up all these reasons, then: compared to six or seven years ago, the process of reform today – which we think of as reasonably complete marketization, monetization, and modernization – would be (1) more unattractive to begin with; (2) more difficult technically and more costly to successfully complete; (3) more painful for the population to endure; and (4) more burdened by accumulated past unpaid costs, past debt in the broad sense. In other words the virtual economy is a trap.



## 7. Escaping the Virtual Economy Trap

If, as we have argued, the virtual economy represents an adaptation of behavior to what would otherwise be an unsustainable environment, this suggests that the answer of how to escape this trap can only come from examining this broader environment itself.<sup>38</sup> We suggest that this environment was created by what we have termed post-Soviet Russia's impossible trinity.

### 7.1. The Impossible Trinity<sup>39</sup>

An imperative for any state is national survival. The definition of national survival and the cost of meeting this imperative depend on the external environment in which the country is located. It also depends on the dominant vision of the nation shared by the leadership. What is critical, however, is to recognize that national survival is an imperative; it is impermissible to allow other policies, no matter how desirable in themselves, to seriously threaten the very existence of the nation. National survival, guaranteed first and foremost by national defense, is thus a policy imperative for Russia.

Post-Soviet Russia's goal of shedding its totalitarian past added two additional policy imperatives: development of democracy and a modern market economy. As a result, Russia faced a "trinity" of imperatives:

- national survival
- democracy
- a transparent market economy

Under the specific circumstances which Russia was in when it entered its transition, the three elements of this trinity were fundamentally irreconcilable. Owing to Russia's initial conditions at the onset of transition it was an impossible trinity.<sup>40</sup>

Russia entered the transition with security needs inherited from the Soviet era, albeit with an economy only about 60% of the size of the Soviet Union. These

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<sup>38</sup>Just as in natural history changes in the macro environment such as climatic changes altered the course of evolution; e.g., the extinction of the dinosaurs.

<sup>39</sup>See [13, chapter 9] for an extended discussion and analysis.

<sup>40</sup>This notion was first used by Robert Mundell to describe an economy that tried to have a fixed exchange rate, an independent monetary policy, and a regime of capital mobility.

security needs were exacerbated by the implications of the breakup in terms of Russia's new borders. Hence, even without any short-term economic problems the objective security imperative would press heavily on the now smaller economy. But the economic collapse reduced the capacity to meet those security needs. Russia was in a unique situation because it suffered a sudden economic collapse relative to its security needs.<sup>41</sup> Given that level of economic performance, Russia would have had to spend more than a democracy can sustain in order to have adequate defense. Hence Russia could not fulfill all three imperatives in the trinity. Why? Suppose that Russia had a true market economy, one that was monetized and transparent. Then to support its security needs, it would have required defense expenditures relative to GDP beyond what any free society would be willing to sustain. Hence, one of the elements of the trinity—security, democracy, or market economy—had to be sacrificed.<sup>42</sup>

The problem for Russia, in the wake of the Soviet collapse, was to meet the two new imperatives. Notice that even had the economy suffered no short-term difficulties associated with reform the task would have been daunting.

The one way out of this dilemma was the route that caused so much initial optimism: redefining down the security imperative. The end of the Cold War was taken by many to mean that Russia's security needs would be much reduced. With a less hostile security environment, Russia could satisfy the security imperative, implement democracy, and take on economic reform. Hence, the initial attempt to solve the dilemma of the impossible trinity was affected by maintaining a pretense with respect to the first imperative, national security. For an initial period, both the West and Russia's leaders pretended that Russia had less of a security dilemma than it actually did, and that its defense capability was stronger than it really was. The idea that "the Cold War is over" was that the West would ensure a better international environment for the new Russia. This was the essence of the Kozyrev foreign policy: lessening international tensions in order to foster reforms. At the same time, everyone pretended that Russia's strength was much greater

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<sup>41</sup>We assume that this is an unprecedented event, and another aspect of Russia's unfortunate situation of losing the peace rather than the war.

<sup>42</sup>This analysis underscores how different Russia's situation was in comparison to that of Poland or even China. Neither had Russia's security needs. Poland, in fact, had its security needs lessened due to the dismantling of the Warsaw Pact and NATO expansion. China does not have the insecure borders problem that Russia does. Russia is unique in its mismatch between economic capacity and national security demands. An excessive defense burden helped destroy the Soviet economy. The new Russia, economically weaker than its predecessor, could not possibly sustain an even higher defense burden than the USSR.

than it was.

NATO expansion ended the pretense of a peaceful environment. The first Chechen war ended the pretense of Russian strength. At that point at the latest, it was evident that the only way to meet the security imperative was to devote more resources to defense. But if security is the ultimate imperative, and pretense about it is no longer possible, then that left a choice between abandoning democracy or abandoning the market economy. In the event, the pretense was shifted to the economy. Russia ended up with a non-transparent, pretend, market economy: which we know as the virtual economy. The virtual economy allowed for greater spending than was politically feasible thanks to the non-transparent mechanisms of offsets, barter, etc.

This version of events has a provocative implication. To the extent that Russia was able to make serious moves towards the market in the first years of transition, it was in part because pretense was concentrated on the security imperative. Once the possibility of continued pretense vis-a-vis the security imperative was eliminated, Russia had to shift the pretense to either democracy or the market economy. The price of preserving real freedom was the end of serious efforts to create a true market economy.

## **7.2. The Way Out**

Russia's fundamental dilemma is the discrepancy between its security needs and its economic capacity. If that discrepancy is not eliminated but merely covered up, Russia is likely to proceed through a series of steps to a much less benign outcome than is now the case. Its true economic capacity will continue to decline. The effort to sustain the defense apparatus (to fulfill the first imperative) will demand an ever larger share of true national wealth.

With security imperatives pressing on a steadily decreasing economic capacity, the options available to Russian leaders are not very pleasant. Given that the security imperative must be met, resort to heavier dependence on nuclear weapons will reduce the cost of meeting this goal. This means reliance on a more dangerous means of meeting the imperative. The problem is that cheaper forms of maintaining national security are more dangerous.

The other reaction to an ever-shrinking resource base will be to end the pretense with regard to the economy. As the economy shrinks it will be ever more difficult to extract resources through pretense and through the voluntary contributions of value producers induced to contribute so that they can continue to

benefit from good leakage. At that point, the security imperative will come into conflict with the goals of a market economy and democracy. It is hard to see how a return to a centrally planned economy can be accomplished without the abandonment of democracy.

Two things are required to avert that scenario. (1) Russia's security needs have to be lowered; and (2) its economic wealth must be increased. But the message of this discussion is that the steps must come in this order. Russians will never be able to abandon the pretense of the virtual economy in favor of a true, transparent market economy until they can be certain that their national survival is not at risk.

## A. Appendix

Our goal in this appendix is to explain the process by which the virtual economy crystallized using an evolutionary analysis. As we have noted, the virtual economy represents an adaptation. It is not the Soviet system renamed, but rather an adaptation to the changes brought about by reform and transition. Indeed, we could think of it as a mutation. Incomplete shock therapy failed to wipe out loss-making enterprises. The new strain, virtual enterprises, make it harder for new enterprises to compete. The greater the number of virtual enterprises the greater the relative disadvantage for market-type enterprises. The reason is that virtual enterprises operate under different rules.

One way to see the effects of incomplete shock therapy is to analyze the evolutionary process of enterprise behavior. Suppose that enterprises can choose to behave as market-like ( $M$ ), Soviet ( $S$ ), or virtual ( $V$ ).<sup>43</sup> The relative payoff for each of these strategies will depend on the choices of other enterprises. It may be that the market system is more efficient if all enterprises are market-like enterprises; indeed, this is the assumption we make in this section. But that is not the critical question for transition. Rather, we want to know if there is a path from the command system to the market economy. It may be that the market is more efficient if all enterprises are market-like. Nonetheless, it may be impossible for the market system to invade and overtake an economy that is populated primarily by Soviet-type enterprises.

A crucial question for transition is whether the market system can be approached gradually. A simple way to study this question is to see how the choices of strategies evolves based on the populations of the three types of enterprises. We study this question in the form of a simple model with three strategies: Soviet ( $S$ ), Market ( $M$ ), and Virtual ( $V$ ). The payoff that an enterprise receives depends on the strategies that other enterprises are playing. Let  $\pi(i, j)$  be the payoff to an enterprise choosing strategy  $i$  when all other enterprises choose strategy  $j$  ( $i, j = S, M, V$ ). We assume that the payoff to being a market enterprise is greatest when other enterprises choose the market strategy, and it is lowest when all other enterprises follow the Soviet strategy.<sup>44</sup> Hence the payoff to the market

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<sup>43</sup>This is a poor use of terminology. The virtual economy refers to an economic system, not a particular type of enterprise. The virtual economy contains both inefficient manufacturing companies and *Gazprom*. But it is simpler to refer to enterprises that use barter and offsets as virtual enterprises, as a second-best type of shorthand.

<sup>44</sup>This is somewhat counter to the analysis of partial reform, ala Murphy-Shleifer-Vishny. In their analysis, market-like invaders can prosper in an environment of state-owned enterprises by

strategy is:

$$\pi(M, M) > \pi(M, V) > \pi(M, S)$$

and similarly for the virtual and Soviet strategies:

$$\pi(V, V) > \pi(V, S) > \pi(V, M)$$

$$\pi(S, S) > \pi(S, V) > \pi(S, M)$$

Notice also that if the market economy is assumed to be socially efficient and a fully soviet economy is least efficient. Thus,  $\pi(M, M) > \pi(V, V) > \pi(S, S)$ .

An illustrative payoff matrix that shares these assumed payoffs is given by:

	Market	Soviet	Virtual	
Market	5	0	3	(A.1)
Soviet	0	3	1	
Virtual	2	3	4	

where the numbers are payoffs to a row strategy against a population of column strategies. Hence,  $\pi(M, M) = 5$ ,  $\pi(M, S) = 0$ ,  $\pi(M, V) = 3$ , etc. Notice that the payoff matrix given above has the following features:

- The Soviet enterprise is (weakly) dominated by the Virtual enterprise: the Virtual enterprise always does as well as the Soviet enterprise and sometimes better.
- Against a Soviet enterprise the Virtual enterprise does as well as the Soviet enterprise.

Most of the payoffs in A.1 are straightforward. The fact that  $\pi(M, V) < \pi(V, V)$  is worth comment. A market enterprise that operates in an economy with many virtual enterprises is under threat precisely because of the fiscal pressure from the government. With many virtual enterprises, enterprises that operate in the monetary economy are prey to the tax authorities. The relative situation of a market-like firm is decreasing in the number of virtual enterprises because the latter are able to barter and use tax offsets to reduce the real value of liabilities.

There are three pure strategy equilibria in this game. One consists of all Market enterprises; this is the most efficient. A second equilibrium consists of all

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purchasing inputs from state-owned enterprises at below market prices. The case is not directly related, however, because there is no discussion of how the surplus (bribes) is distributed, so we cannot really discuss relative fitness.

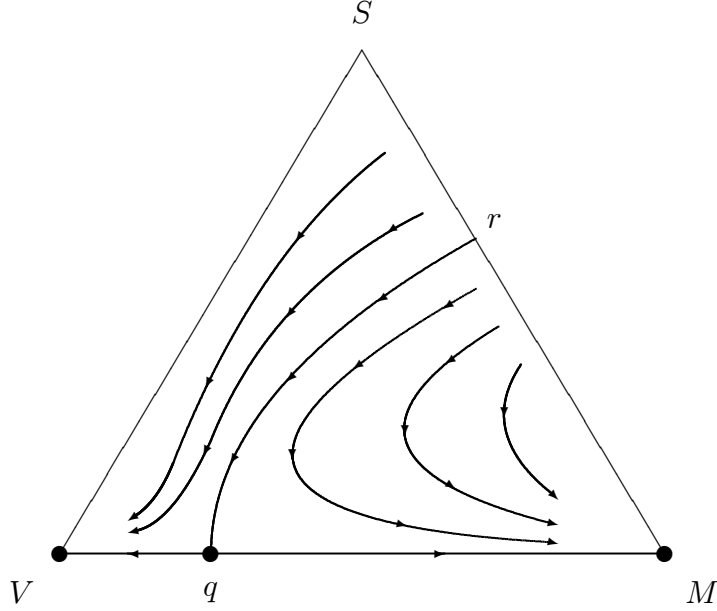


Figure A.1: Some Evolutionary Dynamics

Virtual enterprises. The last one consists of all Soviet enterprises but this is, of course, weakly dominated. In addition, there is also a mixed equilibrium  $q$  with  $\frac{1}{4}$  Market enterprises, no Soviet enterprises and  $\frac{3}{4}$  Virtual enterprises.

Notice that if there were no Soviet-type enterprises we would not expect to see any virtual enterprises. The reason is that the “all market” equilibrium dominates the “all virtual” equilibrium. By assumption we have chosen the all-market equilibrium to be most efficient, and in an environment where the only two types of enterprises are  $M$  and  $S$  the system will end up in the “all market” equilibrium. But when Soviet-type enterprises exist it is possible that the economy will end up in the “all virtual” equilibrium. The presence of Soviet-type enterprises affects where we end up, even though this strategy is dominated by the others.

To see this we assume that the population of each type of enterprise depends on its relative performance compared with the other types. Thus, let  $p_i(t)$  be the proportion of enterprises that choose type  $i = S, M$  or  $V$  at time  $t$ . We can formulate the change in the population by:

$$\dot{p}_i = p_i [e_i A p - p^T A p] \quad (\text{A.2})$$

where  $p$  is the vector of population shares  $(p_M, p_S, p_V)$ ,  $A$  is the  $3 \times 3$  matrix of payoffs from (A.1), and  $e_i$  is the vector of payoffs for an enterprise choosing

strategy  $i$  (i.e.,  $e_S = (5, 0, 3)$ ). The term in the brackets is the difference between the payoff from a particular strategy and the average for all enterprises given the current population shares. Thus the growth in the population of any type of enterprise depends on its *relative* performance compared to the average of all enterprises. For initial populations of the three types of enterprises we can see how strategies evolve. In particular, we can study how the basins of attraction are altered by the initial population shares.<sup>45</sup>

The results can be understood with the aid of figure 5.1. Suppose initially that all enterprises are Soviet-type. We are at the top of the simplex. Now assume that in period 0 a shock occurs that converts some proportion of these enterprises to market strategies. Further suppose that there is a mutation that creates a virtual enterprise. We can let the initial population of these enterprises be arbitrarily small (i.e.,  $p_V(0) = .001$ ). The resulting dynamics depend on how large is this shock. The critical value is  $p_S(0) = r_S = .625$ .<sup>46</sup> If the shock does not bring the share of enterprises choosing the Soviet strategy below this critical value, the dynamics take the economy to the "all virtual" equilibrium. When the shock is greater than this, however, the economy successfully transits to the market. The critical boundary is labelled in Figure 5.1 as the curve  $qr$ .

Another way to think about these dynamics is to consider the basins of attraction. There are two basins of attraction. One is the market economy. The other is the virtual economy. The choices of enterprises eventually take us to one of these basins. In our example, the basins of attraction are given by the regions  $Vq$  and  $Mq$  along the base of the simplex. As is apparent from figure 5.1 the basin of attraction of the market economy is larger than that of the virtual economy. It is interesting, however, to ask what would happen if there was a constraint that the proportion of Soviet enterprises could not shrink to zero. That is, suppose that a political constraint requires the continued presence of state-owned enterprises. In a sense this was precisely the case early in transition, primarily with respect to defense enterprises. The effect of such a constraint is to increase the relative size of the virtual economy's basin of attraction. To see this, notice that such a constraint implies that the economy no longer ends up at the base of the simplex – where the share of Soviet enterprises is zero – but at some higher level. Essentially, the base of the simplex shifts up, with the boundary  $qr$  unchanged. Given the slope of  $qr$  it is apparent that the probability that a virtual mutation

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<sup>45</sup>The dynamics specified in (A.2) is known as the "replicator dynamics" in evolutionary game theory. See, for instance, Weibull (1995) for a further discussion and interpretation.

<sup>46</sup>Of course the specific shares are dependent on the chosen payoffs in the matrix  $A$ .



will take us to the virtual basin of attraction increases.

The market economy is evolutionarily stable. The system is immune to *small* mutations. The virtual economy is also evolutionary stable. The problem is large mutations. When there are both Soviet and Market enterprises the system is vulnerable to the virtual virus.

A key assumption is that when most enterprises are *M* then being a market enterprise dominates being a virtual one. But when there are a sufficient mass of non-market enterprises it pays to be virtual. The reason is that when most enterprises are operating with tax offsets and barter it is very costly to restrict to cash.

**Remark 1.** *Note that this is related to the rotation of the RB curve in R-D space. The RB curve separates the regions where enterprises choose to invest in relations from that where enterprises choose to reduce distance. If the boundary rotates counter-clockwise this increases the domain of attraction of the basin in the Northeast. The key to push market reform is to rotate it clockwise.*

Because the virtual economy is a basin of attraction, it may be stable to small perturbations. Thus reforms that might seem effective on market thinking may backfire. For example, tightening the cash constraint. See [11].

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