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The Political Economy of Policy Instrument Choice: Theory and Evidence from Agricultural Policies

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Abstract
We study the political economy of instrument choice in agricultural and food policies. After a review of the historical evolution of European agricultural price and trade policy instruments since 1880, we develop a political economy model of instrument choice. The key predictions of the model suggest a rational explanation of instrument choice patterns, based on the trade-off between the different cost components of the policies, and internal and external political constraints. An empirical analysis supports the main predictions of the theoretical model. We find that the GATT/WTO agreement had a significant impact.

Keywords: Political Economy; Instrument Choice; Agricultural Policy, GATT, WTO

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1. Introduction

There is an extensive literature on the political economy of public policies, including seminal contributions of e.g. Olson (1965), Stigler (1971), Becker (1983) and more recent contributions, especially on trade policies, by e.g. Hillman (1982), Magee et al. (1989), and Grossman and Helpman (1994). While much of this literature initially focused on explaining the level of policy interventions, subsequent studies focused on explaining the nature of the policies, i.e. why governments chose inefficient policies to redistribute income or protect certain groups (e.g. Cassing and Hillman, 1985; Rodrik, 1986; Coate and Morris, 1995; Acemoglu and Robinson, 2001).

However, this literature on the choice of instruments is mostly restricted to theoretical studies.[1] There are only a few empirical studies on the determinants of instrument choice, including Kono (2006) and Ederington and Minier (2006).

The objective of this paper is to contribute to a better understanding of the political economy of policy instrument choice by developing a general theoretical model and by testing its predictions with new historical and cross-country evidence from agricultural and food policies. The agricultural and food sector is an ideal case for studying the political economy of public policies. The sector is subject to heavy-handed governmental interventions throughout the world. Despite decades (even centuries) of

[1] There is an extensive empirical literature analyzing the determinants of the level of public policies (e.g. Baldwin, 1985; Magee, 1994; 1997; Gawande and Krishna, 2001) including agricultural and food policies (e.g. Gardner, 1987; Olper, 2007; Swinnen et al., 2001).

economists' arguments against agricultural subsidies and tariffs, political factors continue to dominate agricultural policy setting (including trade policy) in both rich and poor countries. The struggle of the World Trade Organization (WTO) to conclude the Doha round of multilateral trade negotiations brought again to the forefront the important role that agricultural policy continues to play in international trade relations.

In poor countries moreover, where agriculture is a very important share of the economy and where food is a major consumption item, the importance of agricultural policy as a public policy issue is obvious. However, also in rich countries agricultural policy remains disproportionately important compared to the relatively small share of agriculture in terms of economic output. For example in the EU, the Common Agricultural Policy (CAP) continues to absorb 42% of the entire EU budget in 2010. Despite a strong decline of agriculture in terms of employment and output in rich countries, agriculture and agricultural policy remains so important for them in their trade negotiations that they are willing to let the WTO negotiations collapse over disputes on agricultural policy.

Agricultural and food policies have changed dramatically over the course of long-term economic development and continue to vary widely among countries, across commodities, and in the choice of policy instruments used. Accordingly, the evolution of policies affecting this sector and the fundamental differences among countries provides an excellent empirical foundation for studying the determinants of policy choices.[2]

[2] As in the general literature, political economy studies of agricultural policy have focused primarily on explaining the level of policy intervention and less attention is paid to the explanation of the instruments used for intervention. See de Gorter and Swinnen (2002) and Swinnen (2010), for reviews of the literature. Studies have attempted to provide an explanation for the stylized facts on agricultural protection, such as the widely observed increase in agricultural protection when an economy grows (Anderson and Hayami, 1986). Theoretical studies attempting to explain these and other facts have stressed the implications of organization costs on the political decision-making process (Gardner, 1987; Olson, 1990), structural factors

Studying agricultural policies also provides a quasi-natural experiment on the impact of the WTO. The distortionary effects of government interventions are equally dependent on the choice of the instrument as on the level of the intervention, a consideration recognized by the WTO through the classification of agricultural policy instruments in green, blue and amber boxes – with the green box for non-trade distorting policies instruments. This distinction between the level of support and the extent of market and trade distortions is at the heart of some important policy reforms, such as those of the EU's CAP over the past two decades. It is generally acknowledged that the 1993 Uruguay Round Agreement on Agriculture (URAA) in the GATT and the current Doha WTO negotiations played an important role in this (Swinnen, 2008).

Finally, an important reason to study agricultural policies is that there are good data available on instrument choice. The OECD annually publishes its indicators of support to agriculture for all OECD countries and provides disaggregation of these support instruments across countries and over time.

The paper is organized as follows. We first review related literature. Next we present some stylized facts on instrument choice in agricultural and food policies. Then we develop a theoretical model and derive some key hypotheses. Afterwards we empirically test these hypotheses using an econometric study. The final section concludes.

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affecting the distributional effects of agricultural protection (Anderson and Tyers, 1988; Honma and Hayami, 1986; Swinnen, 1994), the relative income position of agriculture (Bullock, 1992; de Gorter and Tsur, 1991; Swinnen and de Gorter, 1993), the transfer efficiency of agricultural policy (Gardner, 1983; Bullock, 1992; Bullock et al., 1999) and, more recently, political institutions like differences in electoral rules and the degree of democracy (Beghin and Kerallah, 1994; Swinnen et al., 2001; Olper, 2001; 2007; Olper and Raimondi, 2010).

2. Related Literature

Political economy explanations of instrument choice can be grouped into several categories.[3]

The *imperfect information* approach focuses on how differences in information of various interest groups and politicians affects their preference for certain policies. Because voters are assumed to be not or poorly informed about the effect of policy, politicians have an incentive to select less efficient policy instruments instead of more efficient (and more transparent) ones (Tullock, 1983; Olson, 1982). This approach includes the "obfuscation" explanation which argues that governments use policies which obfuscate the costs of the policies to those hurt by the policies or which obfuscate the transfer itself (Magee et al., 1989; Hillman and Ursprung, 1988; Ray, 1981; Trebilcock et al., 1982). Politicians will try to obfuscate the transfer to hide the influence of interest groups and voters in order to keep their reputation clean (Coate and Morris, 1995) or to protect international relations (MacLaren, 1991).

The policy obfuscation theory depends crucially on the assumption of rationally ignorant Downsian voters (Swinnen and van der Zee, 1993). With increasing voter sophistication, parties must disguise their redistributive activities more effectively. The better informed voters are, the more indirect policies, such as non-tariff barriers, (which are assumed to be more obfuscated) will arise, because they increase voter support for protectionist politicians. But simultaneously the equilibrium level of distortions will rise: the voter information paradox (Magee et al., 1989). Kono (2006) argues that electoral competition reinforces obfuscation effects as some policies are easier to explain to voters.

[3] See also de Gorter (2008) for a recent review.

The obfuscation argument is often used to explain the persistence of agricultural price supports and tariffs in OECD countries, and to explain why non-budget methods of redistribution (such as tariffs) are politically superior to production subsidies and direct income payments (Lindbeck, 1985).

The obfuscation argument is refuted by among others Becker (1976; 1983). He argues that competition among pressure groups favors 'efficient' instruments of redistribution, i.e. instruments that minimize deadweight costs per unit of transfer. 'Seemingly inefficient instruments' will turn out to be efficient if all costs and benefits are taken into account: *"I find it difficult to believe that most voters are systematically fooled about the effects of policies like quotas and tariffs that have persisted for a long time. I prefer instead to assume that voters have unbiased expectations, at least of policies that have persisted. They may overestimate the dead weight loss from some policies and underestimate it from others, but on the average they have a correct perception. This assumption is consistent with … 'rational' expectations"* (Becker 1976: 246-248).

Models following this logic are sometimes referred to as the *efficient redistribution* approach. They are part of a larger class of models focusing on political competition as a key factor determining the choice of policies with rational agents having perfect information. Regarding instrument choice, models in which government policy choice is determined by politicians maximizing political support will yield results very similar to those where pressure groups lobby play the central role. Competition in the political market place, whether between interest groups, or between political parties, or both,

induce governments to choose policy instruments that minimize market distortions (Wittmann, 1989; Besley et al., 2010).[4]

A reason why inefficient policies may still be chosen by rational governments in a perfect information world is when they are used as *compensation* instruments in a larger political economy framework. Compensation through redistributive policies may be required to reduce opposition from those hurt by policies which increase aggregate welfare. This argument fits into the logic of models studying joint policy analysis of public goods and redistributive policies (Rausser, 1992; Swinnen and de Gorter, 2002).[5]

For example, Foster and Rausser (1993) show why governments may prefer price support over lump-sum transfers as price support allows to discriminate between heterogeneous producers. As a consequence, the total transfers with price support, including deadweight costs, may be less than with lump-sum transfers to satisfy a political need to compensate a minimum blocking coalition from vetoing efficiency-enhancing government policies. In this respect, price distorting compensation schemes are the cheapest way of making an efficiency enhancing government policy politically acceptable. The Foster and Rausser (1993) argument is related to more recent theories of inefficient redistribution, based on contractual problems, such as those proposed by Acemoglu and Robinson (2001) and Acemoglu (2003), where inefficient policies and institutions are chosen because they serve the interests of politicians or social groups

[4] See, Polo (1998) and Svensson (1998) for early formal analyses of how lopsided political competition may lead to excessive rent-seeking or lack of inefficient provision of public policy.

[5] Mueller (1989) makes a division between 'allocative policies' and 'redistributive policies'. Rausser (1992) refers to efficiency-enhancing policies as 'political economic-seeking transfers' (PESTs) in contrast with redistributive policies called 'political economic resource transactions (PERTs). Persson and Tabellini (2000; 2003) point to the different incentive structure of democratic institutions, contrasting special interest versus public interest policy. Applications to agriculture are, for example, the joint decision-making on public expenditures on agricultural research and on subsidies to farmers (de Gorter et al., 1992; Swinnen and de Gorter, 1998).

holding political power. Here the emphasis is on the commitment problems inherent in politics: parties holding political power cannot make commitments to bind their future actions because there is no outside agency with the coercive capacity to enforce such arrangements.

Another set of studies focus on *transaction costs*. They typically argue that corret policy analyses should explicitly account for costs involved in the implementation, administration and enforcement of the policies (Coase, 1960, 1989; North, 1990). Coase (1989) refers to economic analyses that exclude transaction and administration costs as "blackboard economics" which has relevance only in the classroom but not in the real world. Taking into account real world transaction costs and constraints may change the evaluation of the relative efficiency of certain instruments (Dixit, 1996).

Interestingly, the existence of transaction costs has been used both to defend and to disapprove the use of certain policies. Coase (1989) concludes that by ignoring transaction costs most studies underestimate the costs of government policy and that existing policies are even more inefficient than usually argued. In contrast, Munk (1989; 1994) argues that including transaction costs in the analysis leads to the conclusion that existing agricultural policies are more efficient than often claimed since the transaction costs are low compared to other policies (like lump-sum transfers). Similarly, Vatn (2002) argues that the traditional argument in agricultural economics preferring decoupled and better targeted policies over price support policy, based on dead weight costs arguments, may no longer be correct when transaction costs are taken into account. A related argument is made by Mitchell and Moro (2006), who argue that compensation

through distortive policies, such as tariffs, may be more effective if one does not know ex ante the amount of transfer needed – as these information costs induce rent-seeking.

A problem with the transaction costs approach to public policy is the limited empirical measures. Indeed, the size of transaction costs of different policies is only rarely measured (North, 1990; OECD, 2007; Rørstad et al., 2007). Although these reasons are understandable to some extent, they can hardly be used as an excuse for ignoring these costs in policy analysis, in particular since there is substantial ad hoc evidence that they do affect policy decisions in reality.[6] Therefore, a relevant analysis of instrument choice should include transaction costs. At the same time however, since data on transaction costs are very limited, we will need to make some assumptions in the empirical application on how to capture transaction costs.

3. Stylized Facts on Instrument Choice in Agricultural Policy

It is impossible to review all the changes that took place in global agricultural and food policy instruments in one paper, let alone one section of a paper. Therefore we limit ourselves here to identify some important "stylized facts" in policy choice with which a theoretical model and its predictions should be consistent. We do so by drawing both on historical and on cross-country evidence. We first present some stylized facts on agricultural and food policies in Europe over the course of the past century and a half. Then, we present quantitative indications on instrument choice in OECD countries over the past 25 years.

[6] For example, if one asks any policy-maker who was involved in the reform of the EU's Common Agricultural Policy (CAP) in the 1990s, why production quota were not introduced in the grain sector as they were in the milk and sugar sector in the 1980s the answer one gets is invariably: production quota are impossible to administer and to enforce in the grain sector. Hence, the key issue is said to be policy transaction costs.

3.1. European Agricultural and Food Policy instruments 1870-2010

It is convenient to start around 1870 since Europe experienced essentially free trade in the 1860s (Swinnen, 2009). Table 1 summarizes important changes in agricultural policy instruments since then.[7]

In reaction to dramatically declining grain world prices in the 1880s[8], import tariffs were introduced in several European countries such as France, Belgium, and Germany in the late 19th century.[9] The destruction caused by World War I resulted in the temporary suspension of most import tariffs since prices were high and supply low. After the war, production recovered and tariffs were gradually reintroduced. In the 1930s tariff rates were increased as surpluses began to appear and as demand dropped during the general economic depression.

Around 1930 a series of non-tariff interventions emerged. A milling ratio imposed the use of domestic grain, and hence restricted the use of imported grain (mostly wheat and rye) for millers. This instrument to protect domestic grain producers was introduced in, for example, France, Germany, Norway, and Belgium. Import quotas for agricultural products were first used in France in 1931. In the 1930s and 1940s some countries also introduced minimum prices, export subsidies and marketing boards. Countries referred to the combination of various policy instruments as "market organization".

When the precursor to the EU, the European Economic Community (EEC) was created, many of these instruments and their administrations and implementing

[7] These stylized facts draw importantly on Tracy (1989), Josling (2007) and Swinnen (2009). For recent political economy analysis of the historical evolution of US trade policy, see the interesting paper of Irwin (2008); for a broad country coverage, see the paper of Williamson (2003).

[8] Grain import prices declined strongly following increasing imports from overseas in the 1870's.

[9] Exceptions were Britain, Denmark, and the Netherlands which maintained free-trade positions for some time.

institutions[10] were integrated in the CAP. Initially, the core elements of the CAP were a market organization designed to maintain a minimum internal producer price. Three instruments were crucial components of the system: import tariffs, domestic state intervention purchases, and export subsidies.

These support policies lead to structural surpluses, high costs for storage and export subsidies, and increasing global market distortions. To constrain the growing costs and distortions, the EEC introduced production quotas for sugar and milk in the 1980s. Because of implementation problems (i.e. transaction costs), the EU did not introduce production quota in other surplus markets such as grains and oilseeds, and opted instead to lower price support and tariffs and to compensate farmers through payments per hectare or per animal in the 1990s.

In the 2000s, the EU further reduced price support and decoupled payment to farms from production by giving farms a so-called Single Farm Payment (SFP), on the basis of historical entitlements. While there is discussion on whether these payments are fully decoupled from production, there is general consensus that they are much less market distorting than earlier policy systems.

It is important to understand that the CAP reforms over the past two decades were influenced by the GATT/WTO negotiations. The 1990s reforms (lowering of tariffs and introduction of direct payments) coincided with the conclusion of the 1994 GATT agreement (including the URAA). The 2000s reforms (decoupling payments) coincided with the WTO Doha Round negotiations.

[10] During World War II, food distribution was strongly regulated to address food shortages and aid consumers. Administrations and institutions were set up to control production, trade, and consumption. While this system was liberalized after the war, the existing administration and institutions remained useful

In summary, some important conclusions from this brief historical review are (a) that the choice of instruments has changed strongly over time; (b) that initially mainly tariffs were used; (c) that substantially less distortionary policies have only emerged over the past 25 years; and (d) that shifts towards less distortionary policies have coincided with GATT negotiations/agreements. Before developing a model that is consistent with these observations, we will review more detailed quantitative indicators from the past 25 years.

3.2. OECD data 1986-2009

Since 1986 the OECD calculates policy support given to agriculture. The total amount of support to agriculture is referred to as Producer Support Estimate (*PSE*). Initially the *PSE* calculations were only for OECD member states but more recently also some other countries, such as China and Brazil, are covered. The *PSE* data cover 28 countries, 12 of which are not OECD members, over the period 1986-2009. For countries not belonging to the OECD, the time coverage is not complete: the first year observation is around 1990-92 and the last is 2007. The OECD's calculation of policy support distinguishes between several instruments. Table 2 presents an overview of instruments used in OECD countries.

For the purpose of our analysis it is convenient to combine the instruments into 'market price support' (*mps*), 'input subsidies' (*is*) and 'direct payments' (*dp*). The first instrument, *mps*, includes all transfers through tariffs, price support and subsidies directly linked to agricultural production. These instruments are typically considered as being the

instruments for governments to regulate markets and prices to support producers in the 1950s, when economic growth caused a growing rural-urban income gap.

most distortive. The second instrument, *is*, are input subsidies and cover a very heterogeneous set of measures, spanning from investment aids and labor subsidies to land protection programs. Finally, the third instrument, *dp*, includes fully decoupled and partially decoupled agricultural payments. These instruments are generally considered the least distortive.

To compare these policy instruments across country and over time, we consider their share in total support (*PSE*), *mpsh*, *ish*, and *dpsh*, respectively. Table 2 and Figure 1 present the evolution of instruments used. In the late 1980s, by far the most important instrument was *mps*. The share of market price support in total support was 82%, whereas direct payments made up only 10%, and inputs subsidies 8%. Interesting, however, Table 2 and Figure 1 illustrate how in the next two decades there was a dramatic change in instrument choice. The share of market price support has declined and that of direct payments increased substantially. By the late 2000s the former had decreased to 49% and the later increased to 61%. In contrast, the share of input subsidies remained about the same.

Table 3 illustrates that there are large variations among countries. In 1986 the *mpsh* varied from 56% in Canada to 100% in Lithuania, and the *dpsh* varied from 0% in several countries to 37% in the US.[11] Also in recent years there remain large differences across countries with, for example, the *dpsh* varying from 0%-1% in South Africa and Chile to 60% in the EU.

Our previous historical analysis suggested correlations between the choice of instrument and (a) the level of development; and (b) the URAA GATT agreement. The

[11] The negative numbers for China and Mexico mean that in those country-years agriculture was taxed, not subsidized.

OECD data are consistent with this. First, when we correlate the share of support given through direct payments, *dpsh*, with an indicator for development (per capita GDP) in Figure 2, we do observe a positive empirical correlation across this countries. There is a similar positive relationship between development and the level of direct payments per unit of output (*dp/q*) (see Figure 3).

Second, Figure 1 indicates that the shift from market price support to direct payments started in the early 1990s, which was the time of the conclusion of the URAA and has continued during the Doha WTO negotiations.

In addition, when we correlate the share of transfers coming from market price support, *mpsh*, with a country's trade status (net export share) in Figure 4, we observe a strong negative empirical correlation. A similar negative relationship exists when the amount of *mps* per unit of output (*mps/q*), instead of the share, is used (see Figure 5).

In summary, this historical and cross-country empirical evidence suggests that the choice of instruments is non-random. As stylized facts, we find that the choice of instruments is correlated with three factors: (a) a country's level of development; (b) the URAA GATT agreement and the Doha WTO negotiations; and (c) a country's trade status. In the next section of this paper we will develop a theoretical model to explain these stylized observations.

4. Theory

4.1. The Model

We use the same static framework as most models in the literature and consider the choice of governments between instruments in the absence of existing policies (see e.g. Hillman and Ursprung, 1988; Foster and Rausser, 1993; Kono, 2006). We assume that

governments have perfect information on the impact of the various policy instruments, so there is no room for policy obfuscation. Consider that for some reason, e.g. a dramatic decline in world market prices for agricultural products, the government introduces policies to support producers' incomes.[12]

We assume that the government has two different policy instruments at its disposal (see e.g. Hillman and Ursprung, 1988; Rodrik, 1986; Coate and Morris, 1995) to transfer income to producers: instruments t and s, which are assumed to have the following characteristics:

	Distortions	Transaction Costs	Impact on Government Revenue
t	High	Low	Positive if net importing; Negative if net exporting
s	Low	High	Strongly negative

Policy t has low transaction costs but high costs of market distortions, and has a positive (negative) impact on government revenue if the country is a net importer (exporter). Policy s causes fewer distortions but is characterized by high transaction costs, and has a strongly negative impact on government revenue, independent of the country's trade status. Even if the country is a net exporter, the impact of instrument s on government revenue is more negative than instrument t's impact. One could think of tariffs vis-à-vis lump-sum transfers, or market price support vis-à-vis direct income support as examples of policies t and s, respectively.

As in Kono (2006), we assume that governments need both voter support and money to stay in power. Money can be raised both through interest-group contributions

[12] There is considerable evidence (Gardner, 1987; Swinnen et al., 2001) and theoretical explanations (de Gorter and Tsur, 1991; Swinnen, 1994) that governments support agriculture when market conditions

and through revenues from the implementation of policy instruments. Our assumptions imply a modified Grossman and Helpman (1994) model of government decision-making where, in line with Maggi and Rodríguez-Clare (2000), the government maximizes a weighted sum of interest group contributions, policy revenues, and total voter support:

$$G(t,s) = C(t,s) + \omega^R(\alpha) R(t,s;\beta) + \omega^V V(t,s), \quad (1)$$

where G is government utility, C are the interest-group contributions, R measures the budgetary costs or revenues of the policy instruments, and V is total voter support. t and s are the income transfers of the two policy instruments, and $\omega^R(\alpha)$ and ω^V are the weights that the government gives to respectively revenue considerations and total voter support. β represents the trade balance of that country, and α is an inverse measure for a country's institutional development. In developing countries – with relatively underdeveloped institutions – raising revenue through foreign trade taxes constitutes the single largest source of public revenue (Burgess and Stern, 1993; Rodrik, 1995; Bates and Block, 2010). The revenue motive is therefore substantially more imperative in countries with less developed institutions. Since α inversely measures the country's institutional development, we assume that the weight attached by the government to the revenue function increases with less developed institutions $\left(\frac{\partial \omega^R}{\partial \alpha} > 0\right)$.

As in Grossman and Helpman (1994), we assume that the interest group consists of active lobbyists that solicit income transfers from the government. For this purpose the interest group offers the government a schedule that lists the interest group's contributions as a function of the income transfers. The interest-group contributions

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worsen for farmers.

$C(t,s)$ rise with the level of the income transfers $(C_t > 0;\ C_s > 0)$, but at a decreasing rate $(C_{tt} < 0;\ C_{ss} < 0;\ C_{ts} < 0)$.[13]

The policy revenue function $R(t,s;\beta)$ is assumed to be decreasing in policy instrument s $(R_s < 0)$, whereas the revenue impact of instrument t can be either positive $(R_t > 0)$ or negative $(R_t < 0)$, depending on the trade status of the country (respectively net importing or net exporting). We assume that $R_s < R_t$ to represent that instrument s has a highly negative impact on government revenue, even more negative than instrument t in the case of a net-exporting country. $R(t,s)$ is concave in the income transfers $(R_{tt} < 0;\ R_{ss} < 0;\ R_{ts} < 0)$. In line with the marginal impact of instrument t being respectively positive and negative for a net-importing and net-exporting country, the impact of an increase in the trade balance, β, on instrument t's marginal revenue impact is negative, i.e. $R_{t\beta} < 0$. The negative revenue impact of instrument s is independent of the trade balance: $R_{s\beta} = 0$.

The function for total voter support, $V(t,s)$, is given by

$$V(t,s) = W(t,s) - b^t \alpha t - b^s \alpha s, \tag{2}$$

where the first term, $W(t,s)$, represents total voter welfare, and the second and third terms, $b^t \alpha t$ and $b^s \alpha s$, measure the total transaction costs related to each instrument. As before, α is an inverse measure for the country's institutional development. In an unfavourable institutional environment where institutions are underdeveloped and the

[13] Subscripts t and s denote partial derivatives.

administrative capacity is low, transaction costs are higher for the same amount of income transfer (Burgess and Stern, 1993). Since policy t involves lower transaction costs than policy s for the same amount of income transfer, we assume that $b^s > b^t \geq 0$. Hence $b^t\alpha$ and $b^s\alpha$ are the average transaction costs per unit of the income transfers t and s.

As both policy instruments are distortionary measures, $W(t,s)$ is decreasing in the income transfers $(W_t < 0;\ W_s < 0)$ at an increasing rate $(W_{tt} < 0;\ W_{ss} < 0;\ W_{ts} < 0)$. Instrument t is more distorting than instrument s, so $W_t < W_s$.

The equilibrium pair of income transfers (t^*, s^*) is determined by the first order conditions (FOCs):[14]

$$\begin{cases} G_t = C_t(t,s) + \omega^R(\alpha) R_t(t,s;\beta) + \omega^V W_t(t,s) - \omega^V b^t \alpha = 0 \\ G_s = C_s(t,s) + \omega^R(\alpha) R_s(t,s;\beta) + \omega^V W_s(t,s) - \omega^V b^s \alpha = 0. \end{cases} \tag{3}$$

[14] The Hessian matrix of the government's objective function is $H(G) = \begin{bmatrix} G_{tt} & G_{ts} \\ G_{ts} & G_{ss} \end{bmatrix}$. In order to obtain a global maximum and to perform comparative statics, this matrix must be negative definite. Since all the Hessian's elements are negative, $\begin{cases} G_{tt} = C_{tt} + \omega^R R_{tt} + \omega^V W_{tt} < 0 \\ G_{ts} = C_{ts} + \omega^R R_{ts} + \omega^V W_{ts} < 0 \\ G_{ss} = C_{ss} + \omega^R R_{ss} + \omega^V W_{ss} < 0 \end{cases}$, the matrix is negative definite if $\det(H) = G_{tt}G_{ss} - G_{ts}^2 > 0$ (Winston, 2004). To secure uniqueness of the equilibrium and reaction function stability, in line with Brander and Spencer (1983) and Dixit (1984), we assume that the own effects of the income transfers on marginal contributions, revenue, and total voter welfare exceed cross effects such that $G_{tt} < G_{st}$ and $G_{ss} < G_{st}$.

Define $h = \frac{t}{t+s}$ as the share of policy t in the total income transfer. We now perform comparative statics on the equilibrium $h^* = \frac{t^*}{t^* + s^*}$ for changes in the institutional development of a country, α, and the country's trade balance, β.

Result 1: *If* $\frac{b^s}{b^t} > \frac{G_{ss}}{G_{ts}} > 1$ *and* $\frac{R_t}{R_s} < \frac{G_{ts}}{G_{ss}} < 1$*:* $dh^* / d\alpha > 0$.

Proof: See Appendix.

Result 1 implies that when total transaction costs are higher and the revenue motive is more important due to lower institutional capacity, ceteris paribus, the relative share of income transfer t^* increases in equilibrium. Hence countries with less developed institutions (α higher) will apply relatively more distorting policies (h^* larger), provided that the transaction costs of the more distorting policy are sufficiently lower than that of the other policy $\left(\frac{b^s}{b^t} > \frac{G_{ss}}{G_{ts}} > 1 \right)$, and that the less distorting policy has a sufficiently more negative impact on government revenue $\left(\frac{R_t}{R_s} < \frac{G_{ts}}{G_{ss}} < 1 \right)$. The latter condition is always fulfilled if the more distorting policy has a positive impact on government revenue $\left(R_t > 0 \right)$.

To illustrate this result, take the specific case of a net-importing country. In that case, $R_t > 0$, and the second condition is fulfilled. If in addition the more distorting

instrument (t) involves no transaction costs, i.e. $b^t = 0$, the first condition holds as well. It is clear from Result 1 and the proof in Appendix that in this specific case, an increase of the institutional development of a country (α lower) will always result in a higher relative share of the less distorting policy instrument s^* in equilibrium (h^* smaller). The result also holds under less strict conditions, which are discussed in Appendix.

Result 2: $dh^*/d\beta < 0$.

Proof: See Appendix.

Result 2 implies that if the trade balance of a country increases (β increases), the relative share of the more distorting policy in the total income transfer decreases (h^* decreases). For example, if for some exogenous reason a country's imports decrease, ceteris paribus, the country will shift to using the less distorting policy relatively more, although it involves relatively higher transaction costs.

4.2. GATT/WTO

GATT and WTO negotiations may have an important impact on the equilibrium choice of instruments. GATT/WTO regulations distinguish between instruments according to their distortionary impact and limit the use of distorting measures while non-distorting measures are not regulated. More specifically, the WTO classifies agricultural policy instruments in green, blue and amber boxes – with the green box for non-trade distorting

policies instruments (see Josling and Tangermann, 1999; Tangermann, 1999; Josling, 2000 for more details).

To analyze this issue with our model, assume that GATT/WTO regulations put restrictions on the use of instrument t but not on instrument s, since the former is more distorting than the latter one.[15] Formally, with such a restriction in place, the government maximizes its utility function in (1) subject to the condition that $t \leq \hat{t}$, where $\hat{t}$ is the maximum level of instrument t as imposed by GATT/WTO regulations. We assume this constraint to be binding, i.e. that in absence of GATT/WTO regulations the equilibrium choice of instrument t would be higher $\left(t^* > \hat{t}\right)$ – otherwise the constraint would have no impact on the equilibrium instrument choices and the analysis would be trivial.

Analyzing the impact of this constraint on the relative share of the more distorting policy in total income support is straightforward. The two unconstrained FOCs in (3) can be interpreted as a set of two reaction functions, $G_t(t,s)=0$ and $G_s(t,s)=0$ (see Figure 6).[16] Restricting instrument t to $t \leq \hat{t}$ is equivalent to cutting off the first reaction function, $G_t(t,s)=0$, at $t=\hat{t}$, for larger values of t. The constrained reaction function consists of the inner envelope of $G_t(t,s)=0$ and the vertical line at $\hat{t}$ in Figure 6. In the constrained equilibrium, the equilibrium level of instrument t is $t^{\#}=\hat{t}$, i.e. what is maximally allowed under GATT/WTO regulations. As Figure 6 illustrates, the impact of the constraint on the level of instrument s is determined by the slope of the second

[15] For political economy analyses of international trade agreements such as the GATT/WTO regulations, we refer to Grossman and Helpman, 1995; Bagwell and Staiger, 1999; Bagwell and Staiger, 2006; Maggi and Rodríguez-Clare, 2007)

[16] For simplicity, Figure 6 assumes that the reaction functions are linear, and that both t and s are positive.

reaction function, $G_s(t,s)=0$. This reaction function implicitly defines s as a function $s(t)$, such that $G_s(t,s(t))=0$. From the total derivative of the latter expression follows that the slope of the second reaction function is $\frac{ds}{dt}=-\frac{G_{ts}}{G_{ss}}$. Our assumption that $G_{ss}<G_{ts}$ (see footnote 14) implies that the slope of this reaction function, $G_s(t,s)=0$, is negative but smaller than 1 in absolute value. Therefore, if t^* is constrained to $t^{\#}=\hat{t}$ (i.e. lower than t^*), it must be that the level of instrument s is higher in the constrained equilibrium than in the unconstrained one $\left(s^{\#}>s^*\right)$. This increase is smaller than the absolute value of the decrease in instrument t because $\left|\frac{ds}{dt}\right|<1$ along the second reaction function. Since $t^{\#}<t^*$ and $s^{\#}>s^*$, it follows unambiguously that $h^{\#}<h^*$. In other words, because of GATT/WTO regulations, the relative share of the more distorting policy in total income support decreases.

5. Empirical Analysis

5.1. Model Specification

In this section, we formally test whether our theoretical hypotheses are consistent with the observed evidence on instrument choices. Following the theoretical model, we select two instrument choice indicators as dependent variables. As a proxy for the instrument *t* we use the share of market price support in total support (*mpsh*). As a proxy for the instrument *s* we use the share of direct payments in total support (*dpsh*) (see section 3 for more details on the two variables).

Our explanatory variables are the following. First, we proxy the institutional development and administrative capacity of a country by real GDP per capita (*gdppc*), taken from the World Development Indicators (World Bank). A country with a high *gdppc* is expected to have better administrations and institutions to implement, enforce and monitor its public policies.

Second, as an indicator of the economic structure (trade status) we use the net export share in total production (*exsh*), based on FAO data.[17]

Third, to capture the effect of external constraints imposed by international agreements, we include a dummy variable, *d_gatt*. This dummy takes the value of 1 since 1995 (0 otherwise). We expect the effect to be negative on *mpsh* but positive on *dpsh*. The GATT Agreement, starting from the 1995 (the first year of the implementation period), has introduced more constraints on the use of highly distortionary policy instruments like *mps*, than on lower distortionary instruments, like *dp*. In fact, fully decoupled policies which are not trade distorting are allowed under WTO principles.

Fourth, to account for path dependency and the persistence of policies, we include the level of the dependent variable in the previous period.

Finally, one may argue that from a conceptual point of view, the empirical model should also include the level of support (*PSE*). By including *PSE* as explanatory variable, one can analyze the relation between the policy level and instrument choice. However, there are two econometric reasons that render the inclusion of the level of support in our instrument choice equations problematic. First, *PSE* is endogenous, as the level of support is likely to depend itself on the policy instrument. Second, our explanatory

[17] More specifically, *exsh* = (export value – import value) / production value.

variables, *exsh*, *gdppc*, and *d_gatt*, are also important determinants of the overall protection level. While the first problem could be solved potentially by using a simultaneous equation model, the second problem precludes finding good instruments for *PSE* in the *mpsh* and *dpsh* equations. We therefore do not include *PSE* in the regressions.

Summarizing, in what follows we will run the following specifications:

$$mpsh_{it} = \alpha_0 + \alpha_1 mpsh_{it-1} + \alpha_2 gdppc_{it-1} + \alpha_3 exsh_{it-1} + \alpha_4 d\_gatt + \nu_{it}$$

$$dpsh_{it} = \beta_0 + \beta_1 dpsh_{it-1} + \beta_2 gdppc_{it-1} + \beta_3 exsh_{it-1} + \beta_4 d\_gatt + \eta_{it}$$

where α_1 and β_1 are expected to be positive; α_2, α_3, and α_4 are expected to be negative; and β_2, β_3, and β_4 are expected to be positive. The theoretical predictions of the coefficient signs are summarized in Table 4.

We first run the regressions using OLS and later do robustness tests using alternative estimation techniques.

5.2. Data

The empirical model is applied to OECD data on instrument choice in 28 countries over the 1986-2009 period (see Figure 1 and Tables 2 and 3).

Before running the regressions we needed to deal with negative values for some dependent variables for observations of the non OECD countries (see Table 3). In some cases the level of market price support and/or direct payments, as well as other instruments (like input subsidies), are negative for some non OECD countries. This raises problems when working with *mpsh* and *dpsh*. The share of a negative level instrument can be higher (lower) than 1 (0), if the total *PSE* has a value that is higher (lower), respectively, than the value of the instrument itself. In the full dataset 13.3% of the observations have negative values for *mpsh* and 7.2% for *dpsh*.

We tried to deal with this problem in three different ways. First, we recalculated *mpsh* and *dpsh* variables using *absolute* values of each instrument.[18] Notice that for all the observations without negative values this has no effect on the *mpsh* or *dpsh* value. This dataset is referred to as "All" in the regression results. Second, we ran the regressions with the original dataset but excluding the negative values for *mpsh* or *dpsh*. This dataset is referred to as "NoNegVal". Finally, we ran the regressions with the subsample of the OECD member countries only, where there are no negative values. This dataset is referred to as "OECD".

5.3. Results

The OLS regressions of our empirical specifications are reported in Table 5. All the relevant variables have their expected signs and are statistically significant at the 95% level or more. Moreover, the adjusted R^2 of the models, ranging from 0.58 to 0.80, indicates the high explanatory power of the selected variables.

Moreover, the model results are robust across different samples suggesting that how we treat the problem of negative values does not affect our conclusions. Indeed, the magnitudes of the coefficients are very close in the samples. The only significant difference is the explanatory power of the model which is somewhat higher when the NoNegVal or the OECD sample are used.

gdppc has a significant negative effect on *mpsh*, the share of market price support, and *gdppc* a significant positive effect on *dpsh*, the share of direct income support. These results are consistent with our theoretical argument that countries with lower

[18] The exact formula used is as follows: $|pse| = |mps| + |dp| + |is|$. Then the share of market price support and direct payments in total support was calculated as $|mpsh| = |mps|/|pse|$ and $|dp|/|pse|$.

administrative capacity and lower institutional development have a preference for price support. Also in line with our hypothesis, the net export share has a significant negative effect on *mpsh*, and a positive and significant effect on *dpsh*.

The 1994 GATT Agreement as captured by the dummy *d_gatt* is significantly negatively correlated with *mpsh*, and positively with *dpsh*. These results are consistent with the argument that the GATT constraints exert an effect on instrument choices: *mpsh* declined on average after the implementation of the 1994 GATT agreement, and *dpsh* increased.

In all regressions the coefficients of the lagged value of the dependent variable are positive and strongly significant. The magnitude of the lagged coefficients, ranging from 0.66 to 0.86, confirm a strong level of persistency in instrument choice.

5.4. Robustness Tests

We performed a series of additional robustness test of our main findings. First, a potential problem in applying OLS to our specification is that the lagged dependent variable can be endogenous to the fixed effects in the error term, which gives the well know dynamic panel bias (see, e.g., Roodman, 2009). A first step to deal with this is by removing the fixed effects from the error term, running the standard Least Square with Dummy Variables (LSDV) estimator. In doing so, we also control for any unobserved heterogeneity that are correlated with our explanatory variables.

Table 6 reports the LSDV regression results. First, taken together, the fixed effects are jointly significant suggesting that their inclusion is correct. As expected, the estimated coefficients of the lagged dependent variable are lower in magnitude, but still strongly significant. Second, all the estimated coefficients retain their expected signs and are

almost always significantly different from zero. There is an increase in the (absolute) magnitude of the *gdppc* effect. The estimated coefficient of *exsh* loses its significance in the *mpsh* regressions, when the ALL sample is considered, and in the *dpsh* regression when the OECD sample is considered. However, the main conclusion from the fixed effects model is that all our key predictions appear quite robust to this specification, but the effect of the trade status, although going in the direction predicted by the theory and often significant, is estimated with less precision.

As is well know, a potential problem with the LSDV estimator is that, when applied to a panel structure where the year dimension, *T*, is lower than the number of individual (countries) *N*, then this dynamic panel estimator may also be biased, due to the endogeneity of the lagged dependent variable. In our specific case, this gives some potential problems with the full dataset (ALL). Indeed, in that case we are in a borderline situation with *T* slightly lower than *N*.[19]

To address this potential source of bias, the system GMM estimator proposed by Blundell and Bond (1998) is used. This means estimating a system with the first-differences and the level equations, where the endogenous variables are instrumented by their level in the first-differenced equation and first-differenced instruments for the equation in level. Results of these additional regressions for the full dataset are reported in Table 7. The bottom of Table 7 shows the Arellano-Bond AR(1) and AR(2) tests, and the Hansen test to check for the consistency of the GMM estimator. The Arellano-Bond test indicates the presence of first order serial correlation, but no second order serial

[19] Specifically, in the OECD sample the average (minimum) years of observations $T = 20$ (13) with $N = 16$. Differently, in the *overall* sample the average (minimum) $T = 18$ (11) with $N = 28$. Note however that, when T is around 20, the estimation bias in the dependent variable is between 2% and 3%. More importantly, the bias on the other explanatory variables is less than 1% (see Judson and Owen, 1999).

correlation, suggesting that the model dynamic is correctly specified. Moreover, the standard Hansen test confirms that in all cases our set of instruments is valid.[20]

As is clear from the numbers reported in Table, these additional robustness checks provide further support to our previous conclusions. Indeed, also in the system GMM regressions the trade status and the level of development, affect negatively the share of market price support, but positively the share of direct payments. Finally, once again the GATT dummy indicates that this international agreement contributed to a shift towards direct income support away from market price support, and the lagged dependent variable indicates strong persistency of policy instruments.

6. Conclusion

A survey of European agricultural price and trade policy instruments from 1880 to 2009 revealed a clear pattern from simple trade barriers (tariffs) to increasingly complex but still very distorting mechanisms of producer support. In recent decades, moves towards less distorting mechanisms of intervention have been made.

We developed a theoretical political economy model in this paper to explain these choices and how various factors may affect these choices on policy instruments. The theoretical model provides an explanation for general observations on policy instrument use: (a) their correlation with the level of a country's institutional development; (b) their correlation with a country's net trade position; and (c) the impact of GATT/WTO negotiations. Moreover, the model explains these key observations without having to rely

[20] According to Roodman (2009), the instrument count does not exceed the number of groups and, to control for instrument proliferation that cause a weak Hansen test, we used the xtabond2 *collapse* option in STATA, instead of all available lags for instruments.

on imperfect information of policy effects by consumers or taxpayers or on theories of bureaucratic inertia and obstruction.

In the last part of the paper we econometrically tested these theoretical predictions using OECD data on instrument choice in agricultural policy. Our empirical analysis confirms the hypotheses and provides strong evidence that the shift from distortionary to less distortionary instruments is positively influenced by institutional development, the net trade status, and the GATT/WTO framework. Moreover, we also find evidence of strong persistency of policy instruments.

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Table 1 Introduction of trade and price policy among European countries

Instrument	Commodity	Country	Date
1. Import Tariffs	Most agricultural	Italy	1878
	Most agricultural	Germany	1879
	Livestock	France	1881
	All agricultural	France	1885, 1887
	Grain	Germany	1885, 1887
	Meat, livestock (grains free)	Belgium	1887
	Meat (grains free)	Switzerland	1891
	Grains, sugar	France, Germany	1931
	Fruits, vegetables	UK	1931
2. Non-Tariff Barriers			
Milling ratio	wheat and sometimes rye	Norway	1927
		France,	1929
		Germany	1929
		Widespread	1930
Import quota	Most agricultural (except wheat)	France	1931
	All agricultural products	Belgium	1932
3. Market organization[1]	Grain	Norway	1926
	Meat, butter, pigs	Denmark	1930
	Cattle, dairy, hogs, veg.	Netherlands	
	Cattle, dairy	Austria	1931
	Wine, grains	France	1931, 1934
	Dairy	Sweden	1932
	All	Germany	1933
	Wheat, rye	Switzerland	
	Milk, butter and cheese	UK	1933,1934
	sugar beet		1935
	Potatoes, sugar-beet, fruits and vegetables	Netherlands	1931
	Grain	Belgium	1933
4. Minimum and Guaranteed Price Support	Wheat	France	1936
	Major foodstuff	UK	1947
5. Export Subsidies	Sugar beet	UK	1930
	Wheat, sugar	France	1936, 1950
6. Target price and Intervention with Threshold prices linked to Variable Import Levies[2] and Export Subsidies	Cereals	EC-6	1962
	Dairy, rice		1968
	Sugar		1968
	Beef and veal	EC-9	1974
7. Production Quotas	Sugar, milk	EC-6, -12	1968, 1984
8. Compensation Payments[3]	Cereals, oilseeds, beef & veal	EC-12	1992
	Rice	EU-15	1995
9. Decoupled Payments[4]	Main CAP products	EU-15, -27	2005

Notes: (1) 'Market organization' refers to the use of combinations of instruments such as: state trade monopolies, marketing boards, state food corporations, intervention purchases, and subsidies in addition to numerous border measures. (2) Variable import levies and associated threshold prices have been abolished in 1995 under the Uruguay Round Agreements of GATT. (3) Payments made to producers to compensate for reduced price support under the MacSharry and later CAP reforms. (4) Payments introduced under the 2003 Fischler CAP reform.

Source: Own interpretation of Tracy (1989, 1996), Bureau of Agricultural Economics, Canberra (1985) and Swinnen (2009; 2010).

Table 2. Support by policy instrument based on OECD PSE database

	1986-88		2007-09	
	Value	*Share*	*Value*	*Share*
Market price support	195,839	0.82	125,215	0.49
Input subsidies	20,400	0.09	33,403	0.13
Direct payments	22,425	0.09	98,146	0.38
Total PSE (Milions US $)	238,665	1.00	256,764	1.00
Percentage PSE	37		22	

Notes: The policy instruments considered are based on the following items of the PSE database: 'market price support' refers to support based on commodity outputs (items A1 and A2, of the PSE database); 'input subsidies' is the sum of payments based on input use and miscellaneous payments (items B and G); 'direct payments' refer to different payments decoupled or partially decoupled from production (items from C to F).

Source: own computation based on OECD PSE/CSE database (2010).

Table 3. Share of market price support, input subsidies and direct payments in PSE

	1986			2009		
Instrument share	*mpsh*	*ish*	*dpsh*	*mpsh*	*ish*	*dpsh*
European Union	0.92	0.05	0.03	0.25	0.14	0.60
United States	0.44	0.18	0.37	0.18	0.30	0.51
Australia	0.75	0.17	0.08	0.00	0.51	0.49
Switzerland	0.83	0.10	0.07	0.54	0.06	0.41
Norway	0.72	0.10	0.18	0.55	0.05	0.40
Latvia	0.99	0.01	0.00	0.26	0.36	0.38
Canada	0.56	0.16	0.28	0.58	0.07	0.35
China	1.09	-0.06	-0.03	0.21	0.48	0.31
Slovakia	0.88	0.08	0.04	0.51	0.19	0.31
Iceland	0.93	0.07	0.00	0.65	0.08	0.27
Czech Republic	0.82	0.05	0.14	0.64	0.11	0.25
Ukraine	0.81	0.19	0.00	0.39	0.37	0.24
Slovenia	0.88	0.09	0.03	0.73	0.05	0.22
Mexico	-1.53	2.53	0.00	0.35	0.43	0.22
Estonia	0.88	0.10	0.01	0.51	0.32	0.17
Hungary	0.80	0.06	0.14	0.54	0.30	0.16
Lithuania	1.00	0.00	0.00	0.63	0.23	0.14
Japan	0.93	0.04	0.03	0.88	0.03	0.09
Turkey	0.77	0.23	0.00	0.92	0.03	0.05
Korea	0.99	0.00	0.00	0.92	0.03	0.05
Romania	0.96	0.03	0.00	0.89	0.07	0.04
New Zealand	0.19	0.48	0.32	0.42	0.55	0.03
Russia	0.65	0.24	0.11	0.54	0.44	0.03
Brazil	1.31	-0.31	0.00	0.53	0.46	0.02
Poland	0.75	0.17	0.08	0.60	0.38	0.01
Chile	0.96	0.04	0.00	0.13	0.86	0.01
South Africa	0.97	0.03	0.01	0.69	0.31	0.00
Bulgaria	0.99	0.01	0.00	0.31	0.69	0.00

Notes: Countries are ranked by their 2009 values of *dpsh*; For new EU member states, the last year corresponds to 2003; for non OECD countries, like South Africa, Chile, Brazil, Russia, and China the first year is around 1990-92 and the last is 2007.

Source: own computation based on OECD PSE/CSE database (2010).

Table 4. Model predictions

	mpsh	***dpsh***
Variable	*Coefficient*	*Coefficient*
gdppc	-	+
exsh	-	+
d_gatt	-	+
$mpsh_{t-k}$ ($dpsh_{t-k}$)	+	+

Table 5. Instrument choice regression results

Dependent variable	***mpsh***			***dpsh***		
OLS regressions	(1)	(2)	(3)	(4)	(5)	(6)
gdppc	-0.0018	-0.0018	-0.0024	0.0015	0.0013	0.0017
	*2.98***	*2.99***	*3.34***	*4.14***	*3.43***	*3.71***
exsh	-0.0650	-0.0469	-0.0641	0.0132	0.0116	0.0185
	*5.51***	*4.31***	*8.58***	*1.45*	*1.64*	*2.29**
d_GATT	-0.0511	-0.0489	-0.0448	0.0197	0.0158	0.0299
	*4.03***	*4.27***	*3.21***	*3.16***	*3.05***	*2.34**
Lagged_mpsh (dpsh)	0.6608	0.7698	0.7214	0.8038	0.8606	0.8102
	*13.99***	*16.95***	*13.56***	*19.01***	*24.65***	*20.77***
Dataset	*All*	*NoNegVal*	*OECD*	*All*	*NoNegVal*	*OECD*
Fixed effects	NO	NO	NO	NO	NO	NO
Obs.	517	448	326	517	480	326
Countries	28	28	16	28	28	16
F-Statistic	82.4	143.3	106.8	152.6	334.6	360.2
Adjusted R^2	0.58	0.74	0.75	0.75	0.82	0.80

Notes: t-statistics based on clustered standard errors under the coefficients. All regressions include also a constant term. ***, ** and * *p*-value < 0.01, 0.05 and 0.10, respectively.

Table 6. Robustness check: Fixed effect regressions

Dependent variable	***mpsh***			***dpsh***		
LSDV regressions	(1)	(2)	(3)	(4)	(5)	(6)
gdppc	-0.0107	-0.0079	-0.0114	0.0085	0.0072	0.0083
	*3.50***	*2.46***	*2.95***	*3.98***	*3.08***	*2.31***
exsh	-0.0571	-0.0804	-0.1096	0.0444	0.0453	0.0792
	1.28	*2.00**	*1.86**	*1.77**	*1.69**	*1.58*
d_gatt	-0.0472	-0.0600	-0.0366	0.0273	0.0279	0.0404
	*2.46***	*3.84****	*2.11***	*2.42***	*3.12****	*4.44****
Lagged_mpsh (dpsh)	0.4582	0.6042	0.5378	0.5671	0.6395	0.5638
	*8.29****	*7.12****	*4.14****	*8.82****	*8.13****	*4.37****
Dataset	*All*	*NoNegVal*	*OECD*	*All*	*NoNegVal*	*OECD*
Fixed effects	YES	YES	YES	YES		YES
Obs.	517	448	326	517	480	326
Countries	28	28	16	28	28	16
F-Statistic	78.7	88.3	92.3	197.8	216.4	243.1
Adjusted R^2	0.64	0.76	0.79	0.80	0.84	0.85

Notes: *t*-statistics based on clustered standard errors under the coefficients. ***, ** and * *p*-value < 0.01, 0.05 and 0.10, respectively.

Table 7. Robustness check: System GMM regressions

Dependent variable	***mpsh***		***dpsh***	
System GMM regressions	*One Step*	*Two Step*	*One Step*	*Two Step*
	(1)	(2)	(3)	(4)
gdppc	-0.0035	-0.0036	0.0023	0.0027
	*3.21***	*2.94***	*2.70***	*2.93***
exsh	-0.1147	-0.1190	0.0195	0.0162
	*5.06***	*4.78***	*1.19*	*1.01*
d_gatt	-0.0882	-0.0871	0.0309	0.0274
	*4.15***	*4.00***	*4.14***	*3.48***
Lagged_mpsh (dpsh)	0.395	0.405	0.693	0.686
	*4.83***	*4.72***	*7.58***	*7.62***
Sample	*All*	*All*	*All*	*All*
Obs.	517	517	517	517
Countries	28	28	28	28
Number of instruments	27	27	27	27
Test for AR(1): Pr > z	*0.000*	*0.002*	*0.003*	*0.015*
Test for AR(2): Pr > z	*0.245*	*0.334*	*0.246*	*0.241*
Hansen overid.: Pr > chi2	*0.315*	*0.215*	*0.417*	*0.464*

Notes: *t*-statistics based on robust standard error under the coefficients. The System GMM estimator is implemented in STATA using the xtabond2 routine, with the option *collapse* to limit the instruments proliferation.

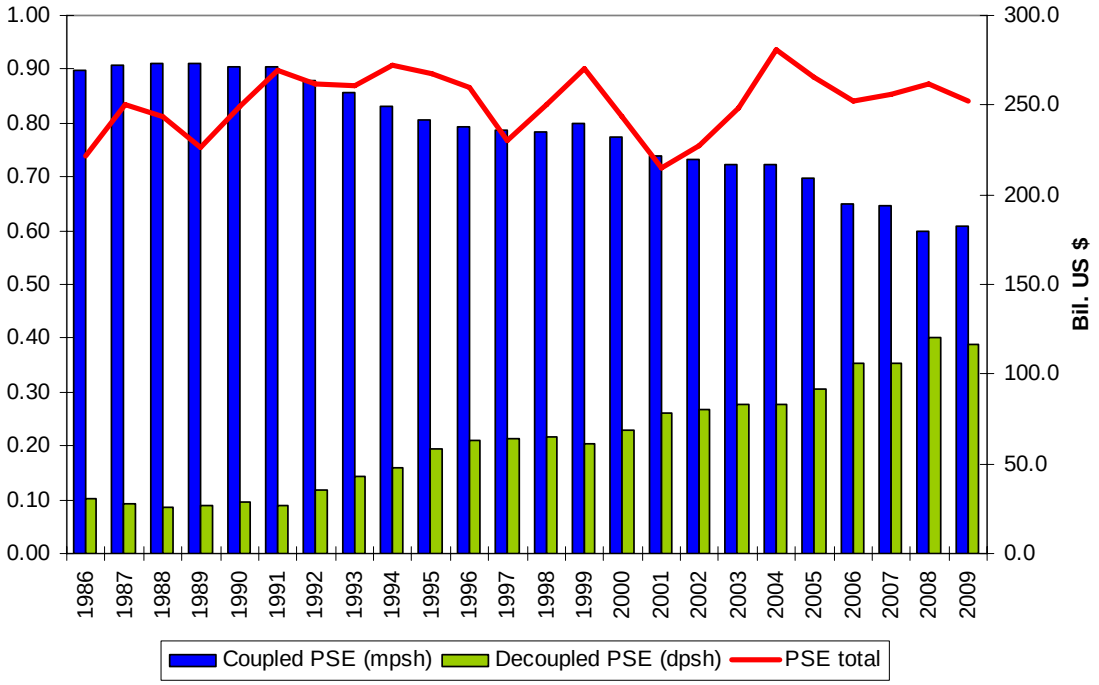

Figure 1. Evolution of total PSE and its coupled (*mpsh*) and decoupled (*dpsh*) components in the OECDs .

Source: own computation based on OECD PSE/CSE database (2010)

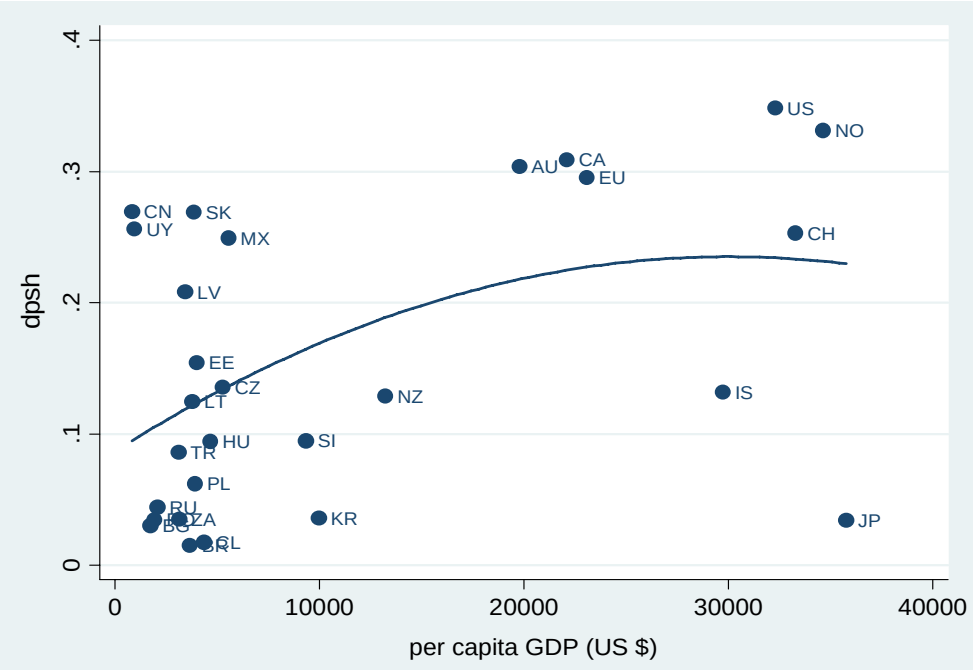

Figure 2. Relation between the share of direct payments in total support (*dpsh*) and the level of development, average values 1986-2009.

Source: own computation based on OECD PSE/CSE database (2010)

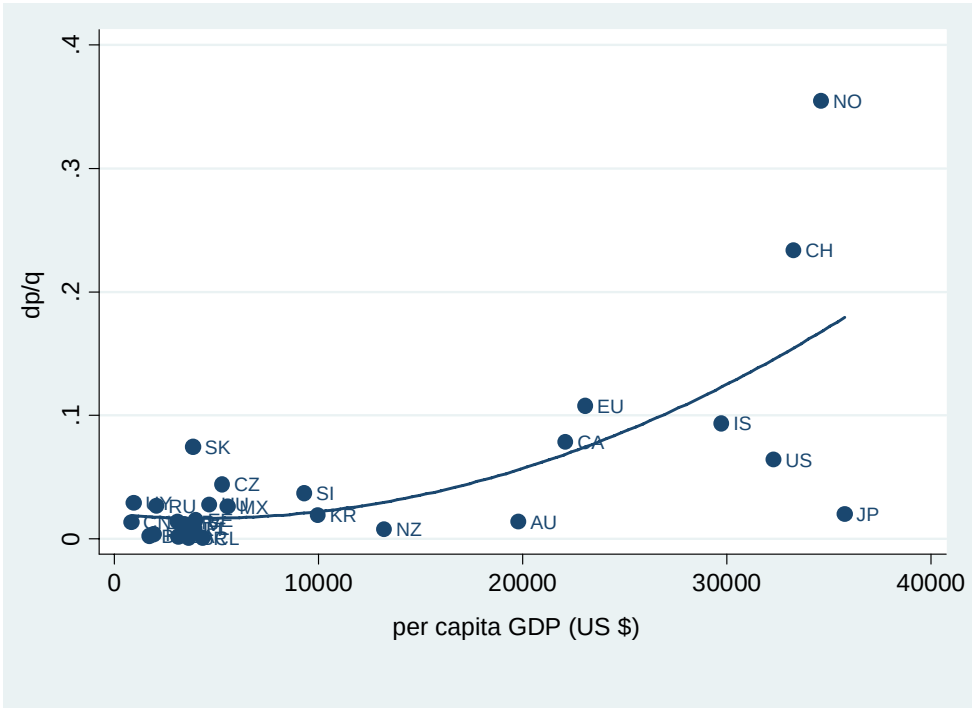

Figure 3. Relation between the level of direct payment support (*dp/q*) and the level of development, average values 1986-2009.

Source: own computation based on OECD PSE/CSE database (2010)

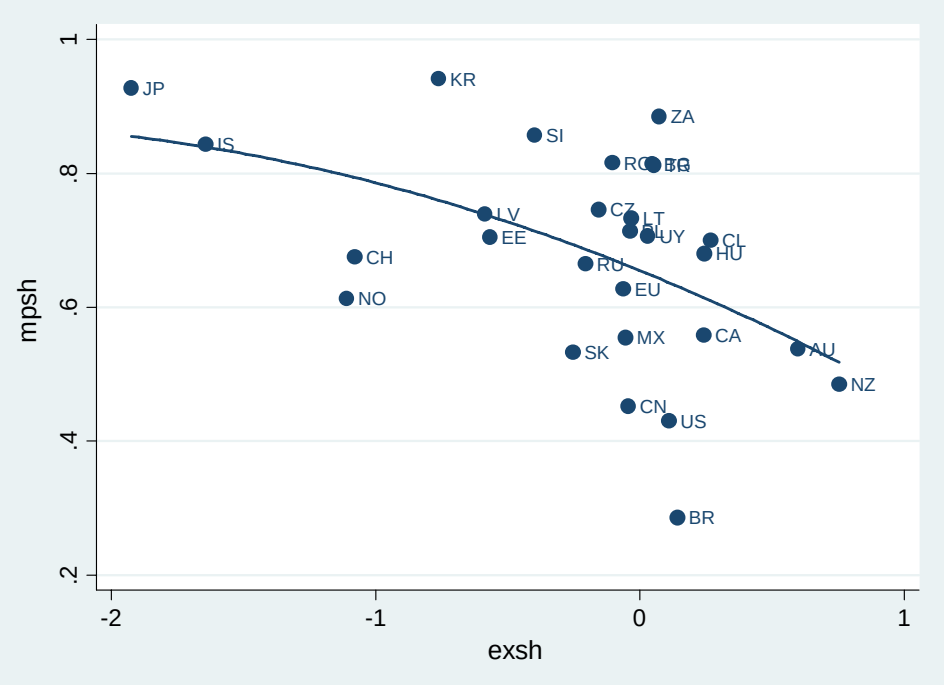

Figure 4. Relation between the share of market price support in total support (*mpsh*) and the net export share (*exsh*), average values 1986-2009. See text.

Source: own computation based on OECD PSE/CSE database (2010)

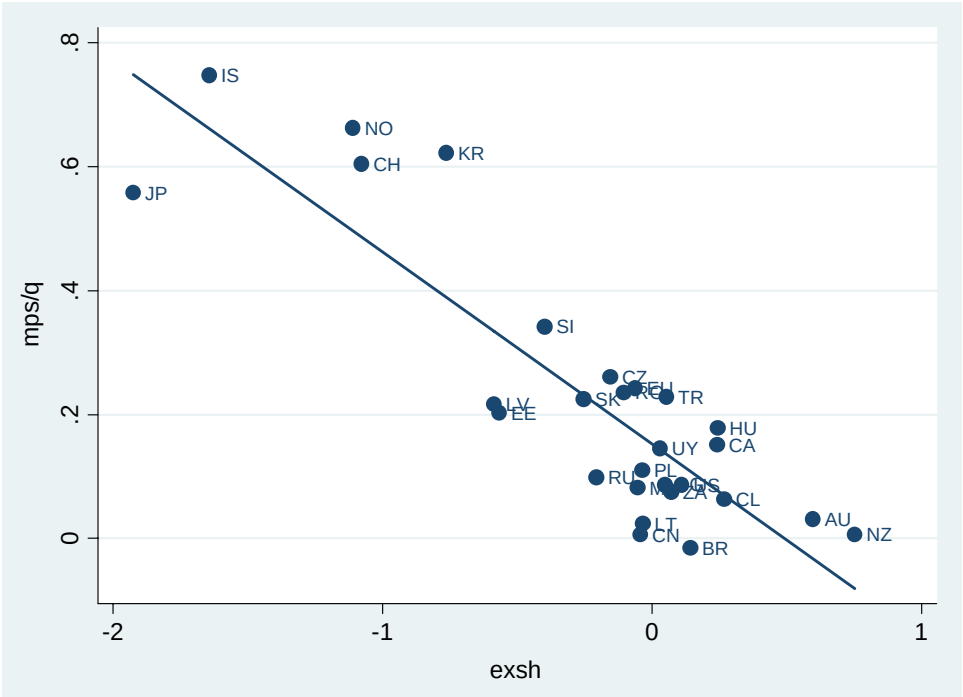

Figure 5. Relation between the level of market price support (*mps/q*) and the net export share (*exsh*), average values 1986-2009.

Source: own computation based on OECD PSE/CSE database (2010)

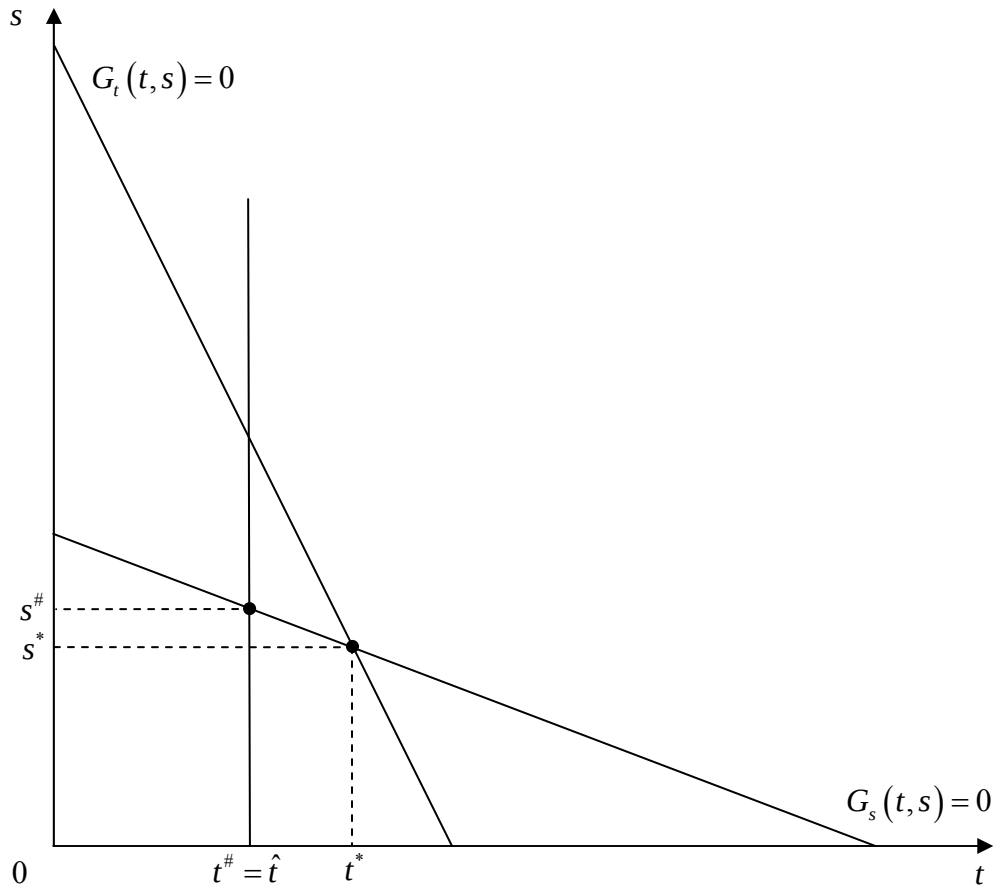

Figure 6. The Impact of GATT/WTO Regulations on Instrument Choice

Appendix

Proof of Result 1:

Using Cramer's rule, it follows from (3) that

$$\frac{dt^*}{d\alpha} = \frac{1}{\det(H)}\left[\omega^V\left(b^t G_{ss} - b^s G_{ts}\right) - \frac{\partial \omega^R}{\partial \alpha}\left(R_t G_{ss} - R_s G_{ts}\right)\right]; \tag{4}$$

$$\frac{ds^*}{d\alpha} = \frac{1}{\det(H)}\left[\omega^V\left(b^s G_{tt} - b^t G_{ts}\right) - \frac{\partial \omega^R}{\partial \alpha}\left(R_s G_{tt} - R_t G_{ts}\right)\right]. \tag{5}$$

Under the assumptions that $\frac{b^s}{b^t} > \frac{G_{ss}}{G_{ts}}$ and $\frac{R_t}{R_s} < \frac{G_{ts}}{G_{ss}}$, it follows that

$$\frac{dt^*}{d\alpha} > 0\,. \tag{6}$$

From the assumptions to secure uniqueness of the equilibrium and reaction function stability, $G_{tt} < G_{st}$, and $G_{ss} < G_{st}$ (see footnote 14), it follows that

$$\frac{ds^*}{d\alpha} < 0\,. \tag{7}$$

Performing comparative statics on h^* gives

$$\frac{dh^*}{d\alpha} = \frac{1-h^*}{\left(t^*+s^*\right)}\frac{dt^*}{d\alpha} - \frac{h^*}{\left(t^*+s^*\right)}\frac{ds^*}{d\alpha}\,. \tag{8}$$

Using (6) and (7), it immediately follows that $dh^*/d\alpha > 0$. ■

The conditions imposed under Result 1 are stricter than necessary. Substituting Equations (4) and (5) into Equation (8) and rearranging gives the following condition for $dh^*/d\alpha > 0$:

$$\omega^V\left[s^*\left(b^tG_{ss}-b^sG_{ts}\right)-t^*\left(b^sG_{tt}-b^tG_{ts}\right)\right] > \frac{\partial\omega^R}{\partial\alpha}\left[s^*\left(R_tG_{ss}-R_sG_{ts}\right)-t^*\left(R_sG_{tt}-R_tG_{ts}\right)\right]. \tag{9}$$

It is clear that condition (9) also holds, such that $dh^*/d\alpha > 0$, for several cases that violate the conditions imposed in Result 1. For example, condition (9) is satisfied when one of the two conditions is violated, but the other condition is sufficiently non-binding. Also, at $t^* = s^*$, condition (9) holds when $G_{tt} \cong G_{ss}$. Hence Result 1 is more general than what the two conditions seem to suggest – the attractiveness of these two conditions is in their intuitive interpretation.

Proof of Result 2:

Using Cramer's rule, it follows that

$$\frac{dt^*}{d\beta} = \frac{-\omega^R}{\det(H)}\left[R_{t\beta}G_{ss} - R_{s\beta}G_{ts}\right]; \tag{10}$$

$$\frac{ds^*}{d\beta} = \frac{-\omega^R}{\det(H)}\left[R_{s\beta}G_{tt} - R_{t\beta}G_{ts}\right]. \tag{11}$$

Since $R_{t\beta} < 0$ and $R_{s\beta} = 0$, it follows unambiguously that

$$\frac{dt^*}{d\beta} < 0 < \frac{ds^*}{d\beta}. \tag{12}$$

Performing comparative statics on h^* gives

$$\frac{dh^*}{d\beta} = \frac{1-h^*}{\left(t^*+s^*\right)}\frac{dt^*}{d\beta} - \frac{h^*}{\left(t^*+s^*\right)}\frac{ds^*}{d\beta} \tag{13}$$

Using (12), it follows that $dh^*/d\beta < 0$. ■