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A Wolfram in Sheep's Clothing: Economic Warfare in Spain and Portugal, 1940-1944

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A Wolfram in Sheep's Clothing: Economic Warfare in Spain and Portugal, 1940-1944

Preliminary: Comments are welcome.

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Abstract

One of the most sustained uses of economic warfare by the United States, at least judged by the variety of means used and the issue at stake, occurred in Spain and Portugal during WWII. We provide an overview of this episode by weaving together findings from the secondary literature and from new research in the Spanish archives. The war evolved through several distinct phases. (1) An oil embargo against Spain, although launched when Germany appeared to be winning the war (July 27 to September 7, 1940), was successful in helping keep Spain neutral because it forced the Franco regime to rethink the costs of joining forces with Germany. (2) Preemptive buying of wolfram (tungsten ore) during the middle years of the war was also successful. It forced the Germans to pay more for and to consume less tungsten, a material crucial for the production of armor, armor-piercing shells, and other war related items. (3) Ironically, a second oil embargo against Spain, undertaken when the Germans were retreating on all fronts (January 22 to May 2, 1944), was less successful. The major goal of this embargo, cutting shipments of wolfram to Germany, was not fully realized, partly because monitoring costs were high. Several special circumstances, in particular the naval blockade and the tendency of sanctions and incentives to push the Salazar and Franco regimes in the directions consistent with their own long-run survival, explain the relative success of the economic war.

A Wolfram in Sheep's Clothing: Economic Warfare in Spain and Portugal, 1940-1944*

I. Introduction.

Economic sanctions and incentives have been used increasingly in recent years as a means of statecraft. They have been used, not because of any great confidence in their effectiveness, but rather because the alternatives, diplomatic persuasion and military force, appear so unattractive. Indeed, the end of the cold war may have produced an increase in the number and diversity of sanctions. (Elliott and Hufbauer, 1999) There is a considerable literature about sanctions including work by Gary Clyde Hufbauer, Jeffrey Schott and Kimberly Ann Elliott (1999), Klaus Knorr (1975), Harry R. Strack (1979), David Baldwin (1985), and many others, exploring various cases, and trying to derive generalizations about the circumstances under which economic sanctions have been or have not been effective. Nevertheless, it is fair to say that the study of economic sanctions is still in its formative stage.

The most intense and sustained use of economic warfare by the United States, at least judged by the variety of means used, and the issues at stake, occurred in Spain and Portugal during World War II. A variety of means were used, depending on circumstances: embargos of oil, offers of loans, and even the buying of strategic materials, in particular wolfram (tungsten ore), to keep them out of enemy hands. All of these methods of economic warfare have been used in recent years. The policy of buying strategic materials, for example, has its modern counterpart in the efforts to buy Russian nuclear materials and to hire Russian

laboratories and scientists formerly engaged in biological research.

This episode has attracted the attention of a number of able historians: David L. Gordon and Royden Dangerfield (1947), Herbert Feis (1947), James Cortada (1971), Paul Preston (1993), and Christian Leitz (1996), among others. Most of this literature, particularly the more recent literature, has focussed on bilateral relationships: Spain and the United States, Spain and Germany, Spain and Britain, and so on. Here we will attempt to create an overall picture of economic warfare in Iberia by weaving these separate threads together. We are also able to resolve a number of the remaining issues based on new research on wolfram carried out in the Spanish archives.

The economic war in Iberia divides into four phases: (1) the "Navicerts" phase which began on September 3, 1939. Under this system the British Royal Navy limited Spanish imports to prevent re-exports to Germany. Although this system remained in place for the remainder of the war, our discussion of it will focus mainly on the early months of the war, when it was the only system in place. (2) The first oil embargo of Spain by the Allies, July 27, 1940 to September 7, 1940. (3) The wolfram period, from the middle of 1941 to August 1944. During this period the Allies attempted to limit Spanish and Portuguese exports of wolfram to Germany by pre-emptive buying. And (4) the second oil embargo of Spain, January 22 to May 2, 1944. Below we will describe developments in each of these periods, and the lessons they hold for the nature and limits of economic warfare.

The paper is arranged as follows. Section II. Describes the Navicerts system and the first oil embargo. This embargo, although undertaken during some of the darkest hours of the war from the Allied point of view, nonetheless appears to have been a success. The Franco

regime was strongly tempted to enter the war on the side of Germany (the episode is known to Spanish historians as the "Great Temptation"), but partly as a result of the embargo, Franco rethought his position and decided to remain neutral. Section III describes developments during the wolfram period. Wolfram became crucial during the war because Portugal and Spain became the only source from which Germany could draw supplies. The Allies attempted to prevent Spanish exports to Germany simply by bidding against Germany for the available supply. This led to an astonishing increase in the price of wolfram in Spain, and generated an income that was of some significance to Spain during this era.

Finally, for a number of reasons, including the cost and the debatable success of the wolfram-buying program, the Allies abandoned the system of competing against the Germans, and instituted a second oil embargo. Ironically, this embargo, described in section IV, although undertaken in military circumstances that were much more favorable from the point of view of the Allies, can be considered a partial success at best. Certain political goals were accomplished, but the economic goal of keeping Wolfram out of the hands of the Germans was not. Finally, section V draws some general conclusions.

II. The "Navicerts" and the First Oil Embargo.¹

On September 3, 1939, shortly after the Britain declared war on Germany, Britain created the Navicert system to limit Spanish and Portuguese (and other neutral) exports to Germany. The intention was that the Royal Navy would control all trade with Europe. The British were especially concerned about oil, because, even at this early date, there was some evidence that Spain had re-exported oil to Germany. Any ship bound for Europe had to have a

“navicert,” a document issued by British consulates that specified the cargo and its destination. If a ship’s papers were not in order the Royal Navy would change its destination by force. The system was a violation of international law. But all that Spain or Portugal could do was protest and comply.

The fall of France created a new crisis in relations between Spain and Britain. When France fell, Francisco Franco, Spain’s rightwing dictator, declared that Spain was not neutral, it was “non-belligerent,” the same language that Italy used before joining the war. The “Great Temptation” (for Franco to join the war), as it is known to Spanish historians, reached its peak in the summer of 1940. On June 14, 1940, ten days after the evacuation at Dunkirk, Spanish troops occupied the international city of Tangier on the straits of Gibraltar.² A Spanish delegation began negotiating with the German government over the terms of Spanish entrance in the war. Franco thought that this was the moment to establish a true empire in Africa. At that time it seemed to many military specialists that the war would soon be over. Franco had to move fast to join the winning Axis.

Neither Germany nor Spain thought that Great Britain would have the determination to continue the fight, and the United States the determination to help Britain. Whether the allies were any clearer about the future at that time is far from clear. Winston Churchill wrote to Franklin D. Roosevelt in a desperate way on June 15th:

“Although the present government and I personally would never fail to send the fleet across the Atlantic if resistance was beaten down here, a point may be reached in the struggle where the present ministers no longer have control of affairs and when very easy terms could be obtained for the British islands by their becoming vassal state of the Hitler empire. A pro-German government would certainly be called into being to make peace and might present to shattered or a starving nation an almost irresistible case for entire submission to the Nazi will.” Kimball (1984, 49).

Roosevelt replied:

“...we are doing our utmost in the United States to furnish all of the material and supplies which can possibly be released to the Allied Governments.”
Kimball (1984, 48).

The threat to Britain posed by Spain's entry into the war was clear. If Spain captured Gibraltar, and fortified the corresponding coast of North Africa, the British fleet would have no way of challenging the powerful Italian fleet. The Mediterranean would become an Italian lake.

With that idea of preventing Spain from joining the war, the Allies embargoed shipments of oil to Spain on July 27, 1940. Embargoes, as a rule, have a bad reputation. The embargo of aviation fuel and other strategic materials to Japan imposed on June 26, 1940, for example, which hardened into a total embargo over the next year, failed to achieve its objectives. But the Spanish embargo was successful because it led the Spaniards to rethink the constraints they faced.

As Eaton and Engers (1999) have shown, embargoes would seldom be observed in a world in which the costs and benefits of embargoes were known by both sides with perfect certainty. They arise because of misperceptions on one side or both about the costs of embargoes. In this case, the embargo arose because the Franco regime did not fully understand a major problem that the Germans already faced, and that Spain would face if it joined the Axis: limited supplies of raw materials. To offset the embargo, and as a reward for joining the war, Spain asked Germany for 400,000 tons of gasoline, 600,000 tons of wheat, 200,000 tons of coal, 200,000 tons of fuel oil, and substantial quantities of other raw

materials, including cotton, rubber, wood pulp, hemp, and jute. (Preston 1993, 372).

Although by this time the Germans had begun to appreciate the determination of Great Britain to fight on with the help of the Americans (illustrated by the transfer of 50 U.S. destroyers to the British) the Germans were still not convinced that they needed Spain. None of the supplies Spain asked for were provided. The effect of the embargo on Spain was dramatic. Badly weakened by the Civil War that had ended only a few months before World War II began, Spain had almost no reserves of oil. Spain was forced to treat with the United States and Britain. The British took the lead in the negotiations (the Spanish preferred the British because of their commercial ties and more conservative government) and an agreement was reached relatively quickly on September 7, 1940. Spain would receive oil and other supplies as long as she remained strictly neutral.

When the battle of Britain began Germany was interested in Spain mainly because bases in the Canary Islands might be useful for the war, still far in the future, between Germany and the United States. Immediate Spanish assistance in defeating Britain was not needed. (Goda 1999). By September 1940 the German attitude had changed. The German Navy pointed out the strategic importance of Spain in its continuing war with Britain. Controlling the Straits of Gibraltar, the Canary Islands, and the Iberian Peninsula would be of considerable help to Germany in the Battle of the Atlantic. The German government now tried to reach an agreement with the Spanish government. Finally, at the end of October 1940, Hitler decided to talk directly to Franco about Spanish entry into the war.³ Hitler and Franco met at Hendaye, in France on the Spanish border, on October 23, 1940.

There were two tracks to the negotiations leading up to and following Hendaye: the

military-strategic and the economic. On the military-strategic side Hitler wanted Franco's help in capturing Gibraltar and pinching off the entrance to the Mediterranean. Hitler also wanted one of the Canary Islands as a base to use against England and, in the long run, against the United States. He also wanted bases in parts of Morocco. Finally, he wanted to keep the final division of French Morocco secret, so as not to raise fears in Vichy France about the future of French Morocco, and possibly to lead the French forces in Morocco to join the free French. For his part, Franco wanted firm guarantees for all of French Morocco and Gibraltar, and he did not want to give up the permanent concessions that Germany asked. On the economic side, Franco again provided a long list of raw materials including prominently food and oil, amounts the Germans thought excessive. The Germans, for their part, wanted substantial mining concessions.

It is impossible to say which gap, the strategic or the economic, was the most important to Franco. He was a fierce nationalist. The idea of giving up permanent concessions to Germany in the Canary Islands, in Morocco, and in the mining industry, would have stuck in his craw. (Weinberg 1994, 177-78). And Hitler's determination to remain vague about what Spain would get in North Africa -- so as not to alarm the French and the Italians -- undoubtedly made Franco suspicious. On the other hand, recovering Gibraltar would have righted an affront to Spanish pride that had persisted since 1704. A look at the map would say that in square miles and pride of possession, Franco would have gained.

In any case, our belief is that the control of raw materials, and especially the oil embargo, a factor largely ignored in most historical accounts, has an equally plausible claim to be the decisive factor that kept Franco from joining the war. The shortage of oil had played

havoc with the Spanish economy. The inability of the fishing fleet to put to sea, for example, caused further food shortages in a Spain that was already hungry. Spanish officials had learned at first hand how difficult it would be for Spain, or for Germany for that matter, to supply themselves with oil in the face of American and British opposition, and how costly a shortage of oil would be. Supplies of wheat for a hungry Spain, moreover, were on their way from Canada and the United States. How certain could Franco be that Germany would make up Spain's desperate food shortage if Spain joined the war? The ability of Germany to supply Spain's needs was obviously more circumscribed than might be inferred from her military success.⁴

In theory, Franco and Hitler agreed at Hendaye that Spain would enter the war at an unspecified future date when Spain was ready. In the months that followed Hendaye Hitler continued to press Franco to join the war, specifically to join in an attack on Gibraltar, an operation that Hitler had code-named "Felix." Abundant supplies would be made available, Hitler asserted, once Spain joined the war. But Franco's government continued to claim that they were not ready. The Allies were supplying wheat and oil. It was far from clear that Germany could or would supply as much if Spain joined the war. A bird in the hand was worth two in the bush.

At the time, the decision to remain neutral appeared merely prudent. Spain avoided a costly oil embargo and received additional supplies of food, but gave up the opportunity of joining the winning side in the war, regaining Gibraltar, and gaining an empire in North Africa. In hindsight, of course, the decision seems nothing less than brilliant. Had Spain joined the war, there was a real possibility that the Allies would have decided to fight their

way into Europe through Spain rather than Italy. (Cipolla 1985, 319). The loss of human and physical capital, under those circumstances, might have been enormous. (It has been estimated that in Italy real GDP fell about 68 percent between 1940 and 1945).⁵

And as a neutral, moreover, Spain was able to reap enormous profits from the sale of a commodity that had been a little noticed before the war: wolfram.

III. Wolfram

Spanish and Portuguese wolfram, tungsten ore, turned out to be critical for the German war effort.⁶ Tungsten has the highest melting points of all metals and is one of the hardest. Steel alloyed with tungsten is extremely tough and heat resistant. It is used in producing armor, armor-piercing shells, and high-speed cutting tools. It also has a number of other military uses: in fireproofing materials, electrical contacts, and so on. (Smithells 1952,12-14).

German metallurgists had been among the pioneers in the commercial development of tungsten. Before the war Germany bought wolfram mainly from China, the British colonies in Asia, and to a smaller extent, from Portugal and Spain. In 1938 Germany bought 14,200 tons in all, with only 119 tons coming from Spain. (Table 1). With large stocks on hand, with the expectation that the war would be short, and with Spain and Portugal only minor suppliers, it was understandable that the role about to be played by Iberian wolfram was not appreciated before the war. The situation changed after the attack on the Soviet Union in June 1941. German demands for wolfram escalated and the Peninsula became the only place where Germany could buy wolfram. The British naval blockade made it difficult to bring in wolfram by sea, and an overland route to China, the major prewar supplier, was impossible after the

attack on the Soviet Union. The only other producer of wolfram in Europe was Sweden, but her production barely covered her domestic consumption.

The Demand for Wolfram

The idea of competing with the Germans for Iberian wolfram originated with the British. Hardened steel seemed to be at the heart of the German war machine. Economic warfare that would reduce the German supply, could be as important as destroying German steel plants through strategic bombing, or by destroying German units in the field. Initially, however, British purchases were limited, and the Americans were skeptical. The U.S. could easily buy wolfram from the rest of the world: Argentina, Bolivia, Brazil, etc. (See Table 2). The United States also had abundant supplies of molybdenum, which was a good substitute in producing hardened steels. Jesse Jones, the head of the Reconstruction Finance Corporation, whose agency would be the conduit for American finance, according to one of the participants, thought the idea of preemptive buying was “silly.” (Feis 1947, 169).

Why then did the United States embark on a policy of preemptive buying especially given the apparent success of the oil embargo? Why not simply tell Franco that if he didn't cut wolfram shipments to Germany, further reductions in oil and other supplies would be made? Too some extent, to be sure, the oil weapon was used. The price of oil was raised, and the flow was diminished in response to particular situations. Eventually, a second embargo was launched to try to force a complete cut off in Germany's supplies of wolfram. But for a number of reasons, it was decided during most of the war to rely mainly buying wolfram away from Germany. First, the Allies were afraid that if they pressed Spain and Portugal too hard

they might drive them into the hands of the Germans. Second, the structure of the industry in Spain (it was a highly competitive "cottage industry") meant that it would be extremely difficult to monitor compliance.⁷

The British were led to consider the wolfram problem before the Americans because Portugal, a long-time military ally and economic partner of Britain, was the major European producer before the war. American and Portuguese economic relations, on the other hand, were rudimentary. Portugal, moreover, although the largest European producer was unimportant on the world stage. In 1939 Portugal produced almost 3,000 tons, but world production was more than 36,000 tons (Table 2), so Portugal's 8.3 percent share of world production was unlikely to draw close attention from the U.S. And Spain, where the main battle over wolfram would take place, produced only 225 tons, only .7 percent of world production, in 1939, an amount that failed to draw any attention from either of the Allies. Prewar production, however, proved a poor guide to what would happen during the wartime wolfram rush. Portugal would produce 22,000 tons between 1940 and 1944, and Spain would produce 6,322 tons. (Table 2).

The open competition between the Britain and Germany for Iberian wolfram started prices rising. In the second quarter of 1941 Spanish prices averaged about 12,500 pesetas (\$1,140 at official exchange rates) at the mine gate. In the third quarter they more than doubled to 25,900 pesetas (\$2,365).⁸ (See Figure 1)⁹ The United States did not begin to consider the idea of preemptive buying seriously, however, until November 1941, and did not agree to the policy until February 1942.

By that time the Portuguese situation had been temporarily resolved. On January 24,

1942, the Germans managed to sign an agreement with António de Oliveira Salazar, the Portuguese dictator (and former economist), that assured the Germans a share of Portuguese wolfram. An order issued on February 3, 1942 created a Portuguese Metals Commission to realize the agreement and control the wolfram trade.

The Portuguese actions were intended to protect Portugal's neutrality and to end a wolfram boom that Salazar believed would destabilize the Portuguese economy. Foreign countries that owned mines in Portugal (mainly Britain, although the Germans owned a few) would be entitled to the wolfram produced in their own mines. "Free" wolfram, wolfram produced by Portuguese owned mines, was to be split. Initially, the Portuguese allocated 75 percent of the free wolfram to Germany, the rationale being that Britain owned more mines than Germany. Later, under Allied pressure, the split was changed to 50:50. The new organization was functioning by June. The Metals Commission bought wolfram from British, American, and German mines at 80,000 escudos (\$3,200) per ton. It resold it to the owners at a price of 150,000 escudos (\$6,000), which included a 30,000-escudo (\$1,200) export tax. Wolfram from the "free" mines was bought at a higher price, 120,000 escudos (\$4,800), presumably because the costs of production were higher at the smaller free mines, and resold to the Allies and the Axis, without adding the export tax, once again at the official price of 150,000 escudos (\$6,000). Kemler (1949, 63).

The agreement with the Germans, and the establishment of the Metals Commission, made 2,800 tons per year available for Germany. In return for the agreement Germany promised to export 60,000 tons of steel and fertilizers to Portugal. For much of the war Portugal would stick to this agreement, despite British and American insistence that the

Portuguese government should cease exporting wolfram to Germany. Eventually, the Portuguese complied, but not until June 6, 1944.¹⁰

Although in principle all exports from Portugal went through the Portuguese government, there was an extensive black market. Wolfram was blended with other products or exported under another name. At times there was considerable smuggling of wolfram from Portugal to Spain. (Spanish production areas abutted Portuguese production areas.) The Allies were heavily involved in organizing and financing the smuggling operation. William Medlicott (1952, 596) estimates that 818 tons were smuggled across the border between January and August 1943. The Germans purchased 550 tons and the Allies 268 tons. The flow reversed, as might have been expected, when prices dropped in Spain in late 1943. Smuggling appears to have continued until August 1944, when the Germans left the Spanish frontier, and the land route between Iberia and Germany was broken.¹¹

While the Portuguese supply was regulated with a heavy (although not always effective) hand, the Spanish industry was allowed to go its own highly competitive way. Many small producers, farmers with pickaxes, dominated the industry. The Franco government taxed the industry, and required an export license, but otherwise let it alone. Allowing the industry to develop in this way, as we will see below, proved to be of enormous benefit to Spain and to the Franco regime.

Once the United States was firmly on board the wolfram-buying program in the first quarter of 1942, the boom intensified. Under the pressure of intense competition between Germany and the Allies, prices (figure 1) increased from 12,500 pesetas (\$1,141) in the second quarter of 1941, to 160,000 (\$14,612) in the second quarter of 1943, a factor of close

to 13.¹² Output (figure 2) increased from 159 tons in the second quarter of 1941 to a high of 906 in the second quarter of 1943. The competition was organized in a simple way. The British purchased wolfram through the United Kingdom Commercial Company; the Germans through their own company, Sofindus.¹³ The British had already purchased a small amount, 72 tons, in 1941. When the British company reported to its Ministry of Economic Warfare that Spanish production was rising in response to a strong demand from Germany, the decision was made, at the beginning of 1942 to purchase as much wolfram as possible.

In March 1942 the United States created the United States Commercial Company, modeled after its British counterpart, to buy wolfram and other raw materials that might be valuable to the Axis. Initially, a board of directors appointed by the Reconstruction Finance Corporation controlled the Company, although the separate Board of Economic Warfare was influential in decision-making. In July 1943 the Commercial Company was transferred to the Office of Economic Warfare that had succeeded the Bureau. In September 1943, the Office of Economic Warfare was transferred to the newly created Foreign Economic Administration. Despite these peregrinations, the Reconstruction Finance Corporation maintained that the Commercial Company was its subsidiary, and in September 1945, when the Foreign Economic Administration was discontinued, the Commercial Company was returned to the Reconstruction Finance Corporation. The Bureau of Economic warfare operated somewhat independently from the state department and the military. So while it is appropriate to view U.S. economic warfare in Iberia as a whole, this does mean that policy reflected the views of a single policy-maker.

Paying for wolfram was not easy even for the Allies. They taxed exports to Spain,

especially oil and fertilizers. But they also allowed the Spanish to accumulate regulated dollar balances in U.S. banks, and shipped gold. The Germans had an even harder time. Occasionally they resorted to looted and counterfeited foreign bank notes. They also shipped gold. Later, as we discuss in more detail below, they were able to raise pesetas by shipping arms and by canceling a substantial part of Spain's Civil War debt.

On the Spanish side there were two main figures: Demetrio Carceller from the Ministry of Commerce (appointed on October 16, 1940), and, Serrano Suñer, from the Ministry of Foreign Affairs (from September 1940 till September 1943). The latter created great difficulties for Spanish relations with the Allies. He was a Falangist and strongly favored the Axis. In an article in the Falangist newspaper *Arriba* he argued that Spain had to join the Axis in its war against the communists and the liberal democracies.¹⁴ Both the British and American ambassadors were disrupted in their evaluation of Spanish economic political conditions thanks to his hostility. On the other hand, Carceller, although also a Falangist, tried to persuade the Allies to ignore the Spanish Foreign Minister. On Occasion, Spain may have benefited from this nice-guy-tough-guy routine. Nevertheless, trade negotiations were disrupted to some extent in the early years of the war by ideological issues and interpersonal conflicts. After Count Jordana replaced Suñer, relations with the Allies improved. From then on Spain's main focus was on making sure that what the Spanish regarded as adequate supplies of oil, rubber, and food were forthcoming in exchange for licenses to export wolfram, and that the wolfram boom continued unabated.

The market price was so high that the Germans did not buy wolfram in May 1942. For this reason the Spanish government refused to license German stocks of wolfram for export.

The German government reconsidered its position, and began buying again in June. The hesitation in prices between the second quarter of 1942 and the third quarter may reflect this episode.

Wolfram gave Spain a card to play in its battle with the United States over oil. If the United States believed that there was some re-exporting of oil to Germany, they would reduce Spanish imports. The Spanish government now had its own weapon, wolfram, with which to respond. If in a particular month Spain was short of oil, the Allies would have difficulty getting licenses to purchase wolfram, the price would be lower than it would otherwise be, and the Germans could purchase more. Economic warfare had become a two-way street.

The Spanish government attempted to exploit the situation in another way. On January 7, 1943 it announced an increase in the export tax from \$5,000 per ton to 15,000 per ton. Both sides protested, and managed to scale the tax back to \$10,000 per ton.¹⁵ Upon first consideration it may seem counterproductive for the side intent on pre-emptive buying to protest a tax which had the effect of reducing German consumption. An infinitely high tax that effectively prohibited both sides from buying wolfram would have served the purposes of the Allies admirably. It could be that in protesting the tax the Allies had simply slipped into a commercial way of thinking that was inappropriate to the task at hand. It is also possible that the Allies were distinguishing among beneficiaries of the Allied purchases. One of the advantages of the wolfram-buying program, from the Allied point of view, is that money spent on wolfram went, for the most part, into the hands of small-scale producers, many of them ordinary peasants and working people. The tax, of course, would strengthen the regime. There may also have been a fear that the Spaniards would secretly rebate the German portion of the

tax.

Wolfram prices peaked in second quarter of 1943 (Figure 1), fell slightly, and then tumbled between the third quarter and the fourth quarter of 1943. The reason was simply that the Germans had run out of pesetas. In response, the Allies abandoned the market as well.¹⁶ Spain, however, came up with a clever ploy to keep the game going. The Franco regime owed Germany a large debt incurred for help during the Spanish Civil War. The Germans agreed to canceled the debt in exchange for a peseta balance that they could use to purchase wolfram. They also promised and delivered military equipment in exchange for pesetas. These weapons were undoubtedly valuable to Germany, which was then engaged in a desperate military struggle with the Soviet Union, and are an indication of how important they considered wolfram. The value of the Civil War debt, on the other hand, is debatable. Clearly, if the Germans lost the war, they would have had a hard time collecting. A realistic market value of the Civil War debt must have been below its nominal value. In effect, the Spaniards had found a way, with a veneer of legality, to price discriminate: charging a lower price to the impecunious Germans and a higher price to the well-heeled Allies.

The agreement between Spain and Germany, which made the clearing balance available immediately, was reached on August 28, 1943. The Germans, however, according to Samuel Hoare (1947, 260), the British Ambassador to Spain, were not "so quick off the mark as they might have been" in obtaining export licenses, or apparently, in purchasing additional quantities of wolfram. The Allies may also have been slow in realizing that the game was to go on. In any case, as figure 1 shows, the resulting rebound in prices did not occur until the second quarter of 1944.

Although the Allied-buying program undoubtedly raised the price of wolfram and discouraged German use, the extent to which German consumption of wolfram was actually reduced is debatable. Production in Spain increased rapidly. Both the British and the Germans had trouble sustaining their purchases of wolfram. And among the Americans there was an intense debate over whether the enormous expense of the wolfram program was worth it, that is whether it was really reducing German consumption, or simply stimulating production and enriching the Spaniards.

The Supply of Wolfram

The impact of the Allied buying program depended on the elasticity of the supply of wolfram. If supply was perfectly inelastic then the program would be highly effective: Each ton of wolfram purchased by the Allies would mean one less for the Germans. If supply was perfectly elastic the program would be completely ineffective: each ton purchased by the Allies would be met by an additional ton of Spanish production, and there would be no decrease in the amount going to the Germans.¹⁷ At intermediate elasticities each ton purchased by the Allies would reduce German consumption by a fraction of a ton.

The Spanish government taxed wolfram production at the mine level at the rate of 3% of the total amount sold. (There was also, as we noted above an export tax). For that reason we have data by mine on output, quality of the ore, the price at which it was sold, and the total value of output, for each mine in Spain during the wolfram boom. Although the records appear to be complete for the years 1941-43, there appear to be some gaps in the records for 1944. In addition there may be some reporting errors due to tax evasion, that probably existed

despite the government's reputation for ruthlessness, and also to recording errors made by relatively poor and uneducated miners. We will return to this problem below.

It would appear that the equilibria that we observe during the boom are essentially points along an upward sloping supply curve. Part of the evidence is the discussion in the previous section which shows that demand fluctuated significantly during the boom, rising dramatically during the first phase of the boom, collapsing abruptly when the Germans ran short of funds, rising again when the Spanish government made additional funds available to the Germans, and then collapsing when the land route to Germany was closed.

The assumption of a stable upward sloping supply curve also fits what we know about the structure of the Spanish wolfram industry. It was a highly competitive industry, consisting of a large number of small mines. The industry was concentrated in Northwest Spain where small outcroppings of ore could be found. The miners were generally peasants, or farm workers, who found it more profitable to dig for ore than to work on the land.¹⁸ Figure 3 plots the number of mines operating during the boom, which rose from 6 in the first quarter to the maximum of 124 in the second quarter of 1943.¹⁹ Figure 4 plots the average output per mine. Average output plummeted as the small producers came in, but then stabilized at 6 or 7 tons per mine.

As the price rose it paid to bring poorer quality sites into production. One bit of evidence for this, although it does not speak directly to the issue of costs of production, is shown in figure 5, which plots the average percentage of tungsten in the ore being mined. In general, the producers in Germany and elsewhere were set up to use ore that was 65% tungsten; lower quality ores required additional processing. When the boom took hold,

however, the average quality of the ore being mined dropped well below the .65 mark.

Figure 6 is a scatter diagram of price on quantity – both measured in natural logarithms. For the most part, the observations fall along an upward sloping line. The major exceptions are the initial observations, realized before the industry had time to respond. There are also some outliers generated by the price slump in the latter half of 1943, when output remained high, perhaps because of the expectation, or the hope that demand would pick up again. Nevertheless, this figure again suggests that we may not be going too far wrong if we fit the convenient “Cobb-Douglas” supply curve.

$$(1) Q = SP^{\alpha}$$

Or in logarithmic form

$$(2) \log(Q) = \log(S) + \alpha \log(P)$$

Where Q is the supply of wolfram

S is a shift curve reflecting investment in the industry,

P is the price of wolfram, and

α is the elasticity of supply

Had the boom been expected to continue for years, there would undoubtedly been additional investment in the industry both private (exploration, machinery, training of workers, and so on) and public (improved highways or railroads into the wolfram mining area) that would have shifted the short-run supply curve to the right. It is even conceivable that the long-run supply curve would have been downward sloping. But given the short-run nature of the boom, and the expectation that it would end with the war – when low cost Asian

producers returned to the European market – the assumption that we were for the most part moving up and down a stable short-run supply curve, and that therefore an OLS regression will identify equation (2) seems reasonable.

Estimating equation (2) with quarterly data yields

The Dependent Variable is Wolfram Production (natural logarithm of metric tons)		
Period 1941:1 1944:4		
Variable	Coefficient	T-Statistic
Constant	-4.49	-1.65
Real Price of Wolfram (Natural logarithm)	0.92	3.79
AR(1)	0.61	2.13
Adjusted R-squared	0.69	
Durbin-Watson Statistic	1.80	

Because of evidence of serial correlation the equation was estimated using a first-order autoregressive correction. Even this adjustment, however, did not completely eliminate signs of serial correlation.²⁰ The supply elasticity is .92, the coefficient on the logarithm of the real price of .65-tungsten ore. Because of the possibility of measurement errors in the underlying data on quantity and price, we also ran the regression in the opposite direction with the following results.

The Dependent Variable is the Real Price of Wolfram (Natural logarithm)		
Period 1941:1 1944:4		
Variable	Coefficient	T-Statistic
Constant	8.83	5.79
Wolfram Production (natural logarithm of metric tons)	0.42	1.63
AR(1)	.41	1.37

Adjusted R-squared	0.57	
Durbin-Watson Statistic	1.94	

This equation implies a supply elasticity of 2.43 (1/.41).

The Effects of the Wolfram Program

The appropriate metric for evaluating the effect of the wolfram-buying program is the reduction in German consumption. In other words, we want to compare QG, actual German consumption of wolfram, with QG*, the potential (counterfactual) amount that Germany would have been able to buy in the absence of the wolfram-buying program. The effect of the program depended not only on the supply elasticity just estimated, but also on the elasticity of German demand, about which we know very little. If we make the assumption that Germany would have spent the same amount on wolfram in the absence of the buying program as in the face of it (assuming a demand elasticity of -1) then we can derive an expression for the effect of the wolfram-buying program. This is a reasonable assumption because the Germans simply ran out of money in the third quarter of 1943, and received additional funds only because the Spanish were willing to supply them to keep the Allies in the market. It seems unlikely that if the price had been lower they would have run through all of their funds and still come up with more. If anything, the assumption of unit elasticity probably biases the results in favor of the Allied-buying program. With this assumption the percentage difference between actual and potential German consumption is

$$(3) \log(QG) - \log(QG^*) = \{1/(1+\alpha)\} \{ \log(QG) - \log(Q) \}$$

This expression makes intuitive sense. The greater is the elasticity of supply, the smaller will be the impact of the Allied-buying program. As the supply elasticity, α , approaches infinity, the difference between QG (actual German consumption) and QG* (potential German Consumption) approaches zero. The buying program has no effect. As the supply elasticity approaches zero, the effect on German consumption becomes the same as the difference between actual German consumption and total production.

Table 5 shows calculations of potential German consumption based on the supply elasticities estimated above. Two extreme cases, perfectly elastic supply and perfectly inelastic supply, are shown by way of contrast. Neither of the extreme cases makes much sense. Perhaps the best estimate is at the “bottom line” of the table. It assumes the mean estimate of the supply elasticity and makes an adjustment for the wolfram purchased by the Germans after the cancellation of the Spanish Civil War debt. In the absence of Allied buying there would have been little reason for the Spanish to enter into this deal on such favorable terms to the Germans. As a crude adjustment we assume that in the absence of the Allied-buying program, and hence in the absence of the cancellation of the Spanish debt, the Germans would have been able to purchase only half of the wolfram they actually purchased after September 1943. All in all, it appears that the Allied-buying program reduced German purchases of Spanish wolfram by about 30 percent, enough, our intuition suggests, to justify a claim of success.

Altogether it has been estimated that the Allies spent about \$170 million on purchases of wolfram in Spain and Portugal, including export fees, bribes, and so on, split about evenly

between the U.S. and Britain. In 1944, the peak year, the Federal government spent about \$88.6 billion on the war effort. So the wolfram-buying program added about .1 percent to the cost of the U.S. war effort. Or to put it slightly differently, wolfram-buying was the equivalent of about 8 1/2 hours of federal spending; 17 hours if the U.S. had shouldered the entire burden. It would be impossible to say with any degree of certainty whether the war could have been ended a few days earlier, and more lives have been saved, if those funds had been invested in some other way. But given the manpower constraints that limited the ability of the U.S. to use more equipment, it may well be that this was the most effective use of these resources.

The big winner, of course, was Spain. Table 4 shows the impact of wolfram on Spanish exports. Wolfram grew from an insignificant 0.4 percent of Spanish exports in 1940 to nearly 20 percent in 1943. In 1943 this was about one percent of national income. The export of wolfram is perhaps the one major exception to Tortella's (1994, 309) generalization: "the Second World War was a lost opportunity for Spain to export many goods." When it came to wolfram, Spain was dealt a good hand, and played it well.

IV. The Second Oil Embargo (January 22 - May 2, 1944)

Frustrated by the ever-escalating price of wolfram, by the cancellation of the Civil War debt -- an operation in which, essentially, the Spaniards used the Germans as a shill to pry higher prices out of the Allies -- the Allies began debating a second oil embargo. Although wolfram was the key issue, "political" and military issues also played a role. These included: (1) German spies in Spain, (2) favorable treatment of Axis aircraft landing in Spain, (3) the continuing effort to keep Spanish forces on the Eastern front, and (4) the stridently pro-Nazi

propaganda in the Franco-controlled press. German spying was a genuine problem. German spies on either side of the Straits of Gibraltar could monitor Allied naval movements. The Blue Division, although only a small part of the total forces engaged, had fought well. Now it was being removed. But a smaller unit, the Blue legion, remained. All of these tilts toward the Axis, and the huge profits won in the wolfram trade, set American public opinion against Spain. Feelings ran strong, particularly on the left, that in a war to the death against Fascism the United States should not be doing business with a Fascist regime. The State Department, moreover, wanted all wolfram exports to Germany cut off by D-Day. Britain, more dependent on trade with Spain, and with long-term financial interests in Spain, was inclined to continue the current policy, but the British were willing, at least initially, to do their part. (Edwards 1999, 4).

Spain was notified of the second oil embargo on January 22, 1944. The Spaniards bargained effectively. They announced a temporary ban on exports of wolfram to Germany while the dispute was resolved. Although some writers have speculated that this ban was turned into fact, it is now clear from evidence in the German archives that Germany continued to import wolfram from Spain during the oil embargo.²¹ In the German Archives there is evidence that in 104.6 tons were imported from Spain in February. There were no imports in March, and this may reflect Franco's promise. But in April 198 tons reached Germany from Spain. (Leitz 1996, 189). Clearly, the Spanish government could not or would not comply, even in the face of a painful embargo.

Spain held out for a face-saving formula that would send token amounts of wolfram to Germany. Spain pointed to its rights as a neutral under international law to trade as it saw fit.

Officials known to be sympathetic to the Allies argued that their position would be undermined if the Allies insisted on a complete ban on exports of wolfram to Germany. And the potential for Germany to use force against Spain, if only in the form of air or submarine revenge attacks, remained despite Germany's deteriorating military position.

The division between the Allies increased as the negotiations with Spain dragged on.

On February 13, 1944 Churchill explained his view about the second embargo to Roosevelt in this way:

“When a large, strong, healthy elephant (no reference intended to GOP) comes into a garden and tramples down the flower beds some perturbation is natural among the local gardeners. As you know, we have had our own point of view about this....” Kimball (1984, 726).

Roosevelt remained convinced, or so he said, that an oil embargo would force Spain to cut off all exports of wolfram to Germany:

“I believe that as a result of our suspension of tankers loading the Spanish situation is developing satisfactory and that if both our Governments (British and American) hold firm we can obtain a complete and permanent Spanish embargo on the export of wolfram to any country.” (Kimball 1984, 728)

On March 30, 1944, Churchill cabled Roosevelt, prefacing his argument in these terms:

“...we feel entitled to ask you to take our views seriously into account in the Iberian Peninsula, where our strategic and economic interest are more directly affected than are those of the United States.” (Kimball 1984, 768).

Churchill then pointed out the reasons for reaching a quick compromise: (1) The danger that Spain would smuggle wolfram to the Germans (there were thought to be between 700 and 1000 tons of wolfram stockpiled by the Germans in the Pyrenees) while negotiations

continued, (2) the potential loss to Great Britain of iron ore from Spain, 42% of their total supply, (3) the loss of Spanish potash that was essential for British agriculture, and (4) the long-run loss of Spanish reliance on British financial resources.

The three-cornered struggle among Washington, London, and Madrid continued for another month. Washington and London became increasingly vexed with each other. Washington constantly asserted that if only the Allies remained firm, they could have all they wanted. London, constantly reiterated its contention that Washington's insistence on complete capitulation was prolonging the negotiations, and harming relations on other important issues. Spain in the British view would resist the humiliation of a total embargo on exports of wolfram to Germany, but would settle for a face-saving formula, with similar practical effects. Finally, on April 25, Churchill told Roosevelt that Britain was prepared to enter a separate agreement with Spain, and to supply her with Oil. (Hayes 1945, 222-23). This threat forced the U.S. State Department to capitulate.

The agreement ending the embargo was reached on May 2. Under the agreement Spain would be allowed to export 20 tons per month in May and June, and 40 tons per month thereafter. The U.S. State Department believed that the invasion of Europe, and the control of France, would cut the supplies of wolfram coming from the Peninsula in any case, so that the main point was to reach an agreement that kept wolfram shipments low until the end of June.

Smuggling undermined the agreement. With the help of sympathetic Spanish officials the Germans managed to move about 512.6 tons of wolfram to Germany in April through early July 1944 in addition to the 80 tons in May and June allowed under the May 2 agreement. Some of this wolfram appears to have been paid for with German gold. Leitz

(1996, 192-93). On the political front, however, the Oil Embargo proved more successful. The German Consulate in Tangier was closed, and some German spies were expelled from Spain. The Press, which was controlled by the government, became less stridently pro-Axis.

When the Germans retreated from the Spanish border in August 1944, the demand for wolfram collapsed. There was simply no way for the Germans to carry wolfram from Spain to Germany, and no reason for the Allies to compete. The price of wolfram, as can be seen in figure 1, tumbled to a level not seen since the German attack on the Soviet Union.

V. A Creative Response

During World War II the United States was forced to deal with a potentially explosive situation in Spain and Portugal. Neither country was at war with the United States, but dictators sympathetic to the Axis ruled both. And in the early days of German triumphs, Spain was tempted to enter the war on the side of Germany. The loss of Gibraltar to a Spanish-German force, and the fortification of Spanish possessions in North Africa, presented a clear danger to British and later Allied forces in the Mediterranean. The questions were first, how to prevent Spain from entering the war on the side of Germany, and second how to minimize the aid and comfort Spain and Portugal provided Germany without driving them into the war. All of this had to be accomplished, especially from the British point of view, without damaging long-term relationships with governments that seemed to be firmly entrenched. The path chosen was to rely on economic warfare.

The initial move was by Britain, which established (contrary to international law) a naval blockade that included Spain and Portugal. The purpose was to prevent Spain or

Portugal from becoming a conduit of supplies bound for Germany. The "Navicert" system, as it was called, although successful in limiting supplies to prewar levels, failed to deter the drift of Spain toward the Axis. Franco was strongly tempted to follow Mussolini and cast his lot with Germany. The Americans proposed an oil embargo to turn up the pressure on Franco. The British, although skeptical, went along.

This embargo proved to be a brilliant, and given the general record of embargos, unexpected success. During the embargo the Spaniards ran desperately short of oil, and the Germans were unable or unwilling to supply Spain. As a result Franco learned how difficult life would be as a full participant in the war, and this became an important factor in his decision to keep Spain neutral. This can be considered an almost ideal use of an embargo. The embargo lasted only from July 27 to September 7, 1940.

This might have been the end of the story, had it not been for the emergence of wolfram (tungsten ore). Tungsten has the highest melting point and is, at high temperatures, the hardest of all metals. It is used for toughening steel and for many other purposes crucial to a wartime economy. Spain and Portugal became the only sources available to Germany after she was cut off from her traditional sources in the Far East. The Allies reached an agreement with Portugal under which foreign-owned mines could continue to supply their home countries, and that additional supplies would be divided between the Allies and the Axis. This was possible in part because the Portuguese had a tightly regulated industry. To limit the exports of the highly competitive Spanish industry the Allies launched a competitive buying program. This time it was the British who pushed for the policy and the Americans (at least some) who were skeptical.

The result was frustrating to the Allies. The Allies did manage to buy about 6,000 tons of wolfram in Spain, and over 9,000 tons in Portugal. Germany was forced to economize on tungsten, and use valuable foreign exchange reserves and ultimately military equipment to purchase the wolfram they did get. But the price of wolfram rose at an astonishing rate. By May 1943 the Allies were paying \$26,000 per ton for some supplies.

The Spanish government proved adept at milking the wolfram boom for all it was worth. When the Germans ran short of cash in August 1943, and wolfram prices began to tumble, the Spaniards accepted first a cancellation of Spanish Civil War debts and then military supplies in lieu of cash. In effect they had found a way to price discriminate, to charge a lower price to the impecunious Germans and a higher price to the well-heeled Allies. The income generated in Spain was only \$280,000 in 1940 and reached, perhaps, \$66,000,000 in 1944. This amount was of some significance to Spain as a whole. In 1944 (the peak year) Spanish exports of wolfram accounted for about one percent of Spanish GDP.

To be sure, postwar defenders of the wolfram-buying program somewhat exaggerated its effectiveness. The supply of Spanish wolfram proved highly elastic. Both the Allies and the Germans drew far more wolfram from Spain during the war, than they ever had before. After September 1943, as we noted above, Spain was supplying wolfram to Germany on the cheap, mainly so that the Allies would have a reason to continue buying. Measures adopted in Germany to conserve tungsten are often cited as evidence that the program worked. But those measures mainly reflect the Allied blockade, the German attack on the Soviet Union that cut off Germany from major suppliers in the Far East, and the high price of wolfram in Spain. Germany would have been forced to economize on the use of tungsten even if the Allies had

stayed out of the Spanish market.

Nevertheless, our judgment is that a program of competing against the Germans for Spanish wolfram was probably the best that could be done under the circumstances. Our estimate is that it reduced German purchases by about 30 percent.

Would a harsher policy, a more restrictive or total oil embargo, have worked better? It seems unlikely. The flow of wolfram to Germany would have been hard to stop, even with the full cooperation of the Spanish government. The competitive organization of the wolfram industry made it difficult to control with edicts from above. And it likely, given the large number of German sympathizers in the Spanish government and military, that cooperation would have been incomplete at best. Indeed, it seems likely to us that nothing short of a full occupation of the wolfram-producing regions of Spain and Portugal by the Allies would have prevented wolfram from reaching Germany.

What might have happened under a more punitive regime is illustrated by the second oil embargo imposed in January 1944. The Second Embargo, although undertaken when the Allies were in a far stronger position militarily than when the first embargo was undertaken, was only partially successful. The embargo dragged on for three months while Spain haggled about the terms for ending the embargo, and played off the Americans who were intent on forcing a complete ban on exports against the British, who were more inclined to agree to a face-saving formula. Eventually, an agreement was reached when the British threatened to break ranks and sign a separate agreement. Smuggling continued during the negotiations and after the agreement ending the embargo was reached. The supply to Germany was not cut until the land route to Germany was cut by military action. Indeed, the decision to abandon

competitive buying once the Spaniards had agreed to strictly limit exports to Germany, may well have been a mistake.

The success of the first oil embargo and the partial success of the wolfram-buying program were due to special circumstances that have not usually been in place when economic sanctions have been imposed, and are not likely to be in place in future cases. First, the Allied naval blockade of Europe meant that the United States had to deal with just one other country, Britain, in order to forge a common policy. That proved hard enough. On several occasions the Franco regime was able to exploit differences between the two Allies. Normally when sanctions are used, however, there is no naval blockade, and a much larger coalition needs to be maintained to make them effective. If Spain had been free to trade with Latin America, for example, it is likely that creating an effective oil embargo would have been far more difficult. The same thing is true of the wolfram-buying program. Had Germany been able to buy wolfram from producers in the Far East, it is unlikely that the Allies could have sustained a successful buying program.

Second, and equally important, the measures used in Spain and Portugal were pushing the existing regimes in the direction of their own long-run self-interest. The Franco regime proved to be one of the longest running rightwing dictatorships on record. He remained in power from the end of the Civil War in 1939 until his death in 1975. The decision to remain neutral during the war, and the economic benefits for a Spain still recovering from a devastating Civil War produced by the Allied-buying campaigns, undoubtedly contributed to that longevity. Unfortunately, the normal case is one in which economic sanctions are being used to try to bring down a regime we don't like. Resistance in those cases is going to be

much stiffer.

Perhaps the most important lesson to be drawn from this episode is that narrow, carefully focused sanctions and incentives can be more effective in some cases than broad sanctions. When pre-emptive buying was first proposed, Jesse Jones of the Reconstruction Finance Corporation thought the idea was “silly.” Sometimes thinking "outside the box" has its uses.

Table 1. German Imports of Wolfram, 1936-40. (In Metric Tons).					
Year	China	India	Portugal	Spain	Total
1936	5,100	900	300	136	8,700
1937	8,037	1,229	304	150	11,400
1938	8,962	1,295	658	119	14,200
1939	4,142	62	638	74	8,000 ^a
1940	800	--	61	394 ^b	NA
<p>Source: Leitz: (1996, 173).</p> <p>^a Approximate figure.</p> <p>^b The increase in Spanish exports between 1938 and 1939 appears to be re-exports of Portuguese wolfram.</p>					

Table 2. Wartime Production of Wolfram in tons.							
Country	1939	1940	1941	1942	1943	1944	1945
China	10,907	8,619	11,334	11,800	8,573	3,184	-----
US	3,217	4,571	6,023	8,422	10,763	9,161	5,055
Bolivia	3,284	4,117	4,284	5,517	6,823	7,810	3,498
Burma (Tungsten)	4,342	4,172	NA	743 ^a	743	743	743
Burma (Tin and Tungsten)	5,593	6,192	NA	1,109 ^a	1,109	1,109	1,109
Portugal	2,932	3,709	5,964	4,049	5,582	3,058	NA
Spain ^b	225	386	446	1,408	2,797	1,285	284
Korea ^c	NA	NA	2,400	2,400	2,900	3,900	1,500
Japan	None	None	667	927	791	650	NA
Siam	341	NA	873	1502	1579	1032	419
Total ^d	36,405	36,413	38,725	44,919	53,422	44,105	19,279
Source: Smithells (1952, 10-11).							
^a Average annual production during Japanese occupation for the years 1942, 1943, 1944 and 1945.							
^b We have substituted our estimates for 1941-44 for Smithell's.							
^c Estimated exports to Japan 1941 to 1945.							
^d The total includes other countries.							

Table 3. Spanish Exports, 1940-1944. In million dollars.					
Product	1940	1941	1942	1943	1944
Wolfram	\$0.28	1.00	16.00	63.18	65.61
Oranges	8.93	36.05	35.58	36.88	21.02
Mercury	8.35	8.61	16.26	6.98	0.02
Olives	6.03	5.02	6.13	10.24	12.24
Iron ore	4.69	5.16	8.59	10.63	12.56
Cork	2.75	7.70	9.25	9.42	7.55
Skins, hides, fur.	1.56	6.36	17.43	12.38	8.78
Anchovies	1.28	6.03	11.40	9.00	0.51
TOTAL (Including other items).	75.78	145.50	208.37	318.86	252.57
Source: Leitz (1996, 172). Figures in British pounds were converted into dollars using exchange rates from Friedman and Schwartz (1982, 132)					

Table 4. The Importance of wolfram for the Spanish economy – 1940-1944					
Year	1940	1941	1942	1943	1944
Wolfram as a percentage of Spanish Exports	0.37%	0.7	7.8	19.81	19.69
Wolfram as a percentage of Spanish GDP	.01%	.03	.32	1.04	1.07
Sources: Exports; Leitz (1996, 172); GDP, Prados (1995).					

Table 5. Preliminary Estimates of the Effect of the Wolfram-buying Program on German Wolfram Consumption			
Supply Elasticity	Potential German Purchases (in the absence of Allied Buying) in tons	Difference Between Potential and Actual German Purchases in tons	Difference Between Potential and actual German Purchases in percent
Zero (perfectly inelastic supply)	7,866	4,755	93%
Minimum Estimate (.92)	5,044	1,932	48
Mean Estimate (1.68)	4,401	1,289	35
Maximum Estimate (2.43)	4,077	966	27
Infinite (perfectly elastic supply)	3,414	0	0
Mean Estimate of Supply Elasticity and an adjustment for the Cancellation of the Civil War Debt	4,138	1,027	29
Source: See text			
Notes: Column (4) is the difference between the natural logarithms of column (2) and actual consumption, multiplied by 100.			

Figure 1
Price of Wolfram in Spain
(1941 Pesetas Per Metric Ton of .65-Equivalent Ore)

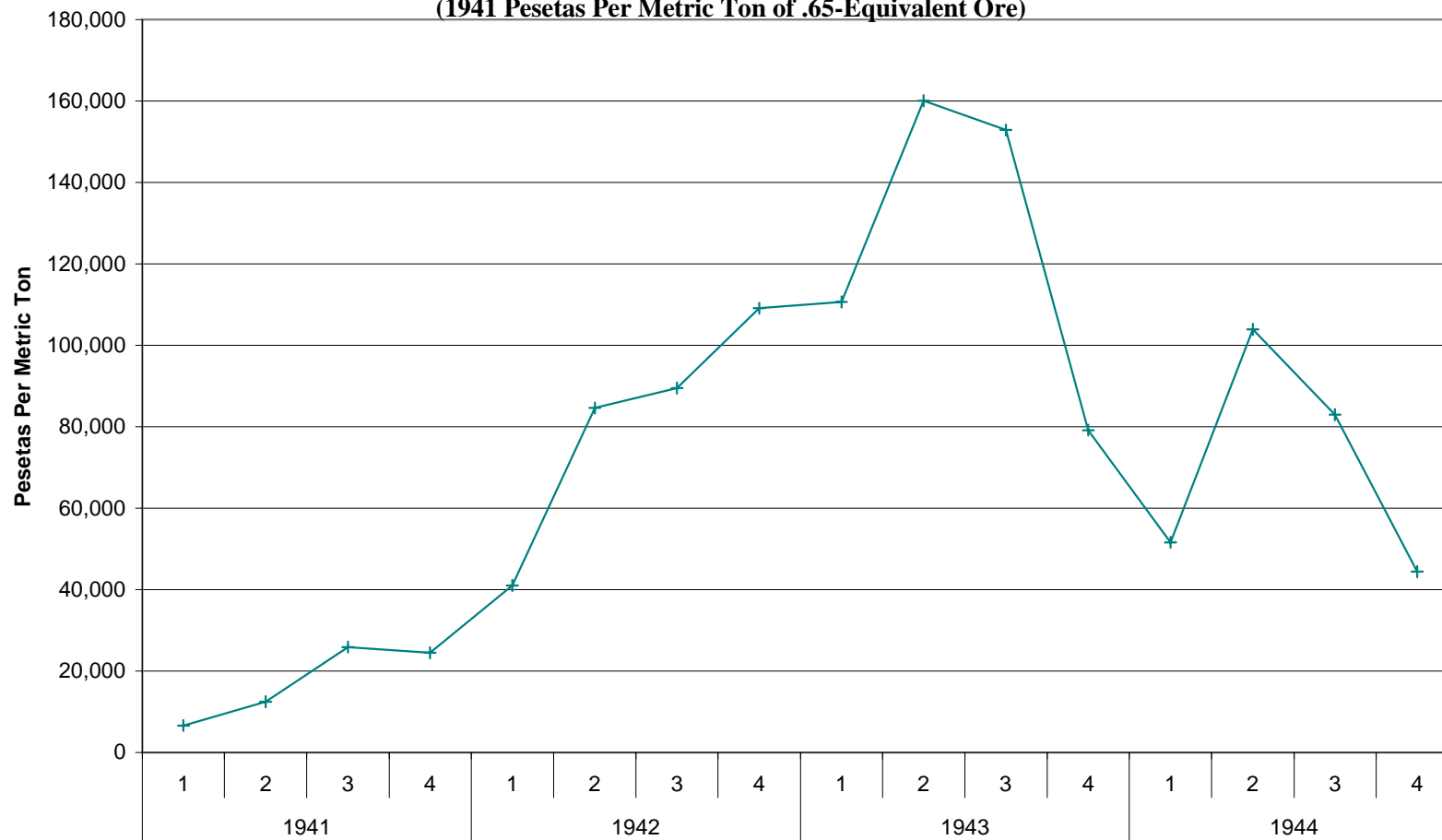


Figure 2
Spanish Wolfram Production
(Metric Tons of .65-equivalent Wolfram)

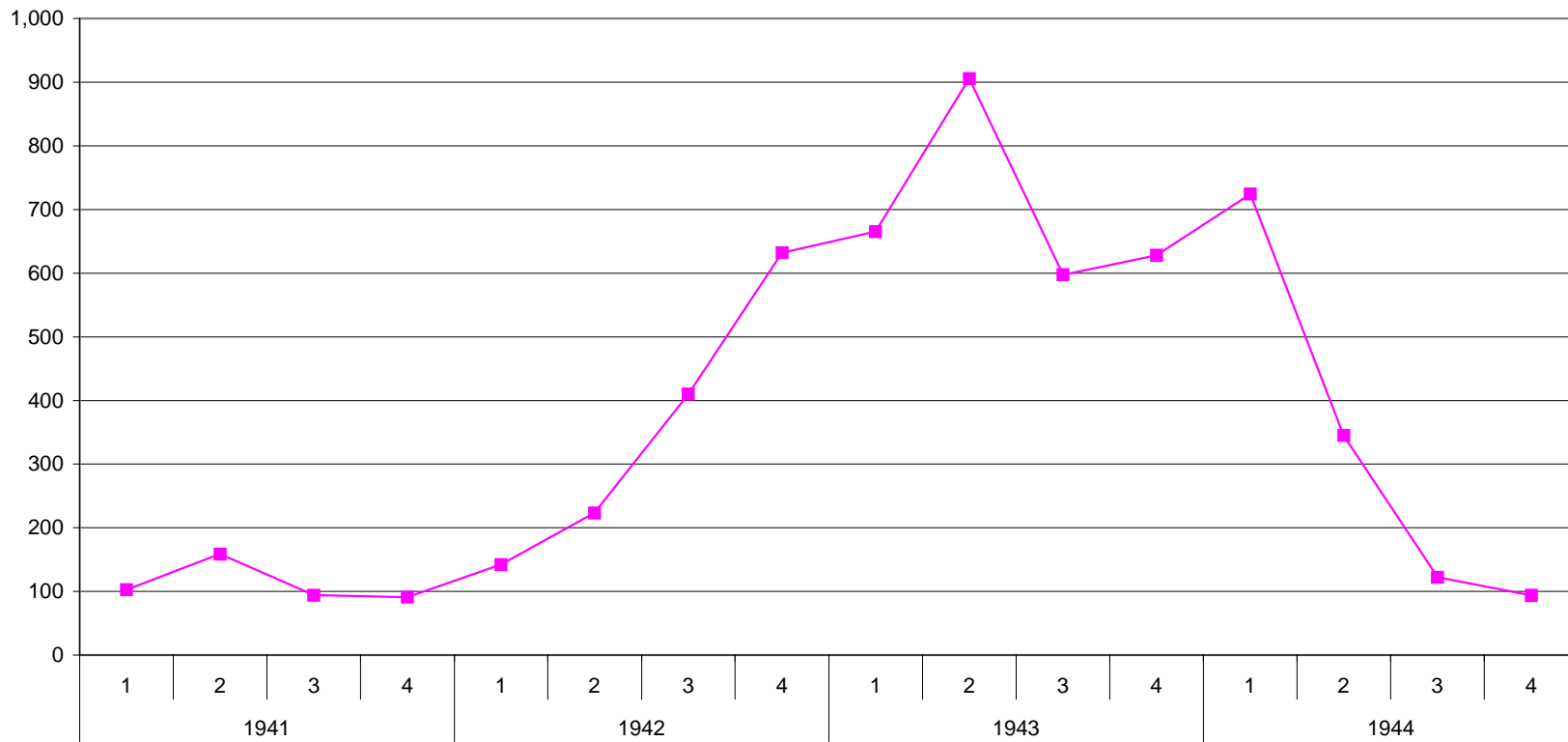


Figure 3
Number of Wolfram Mines

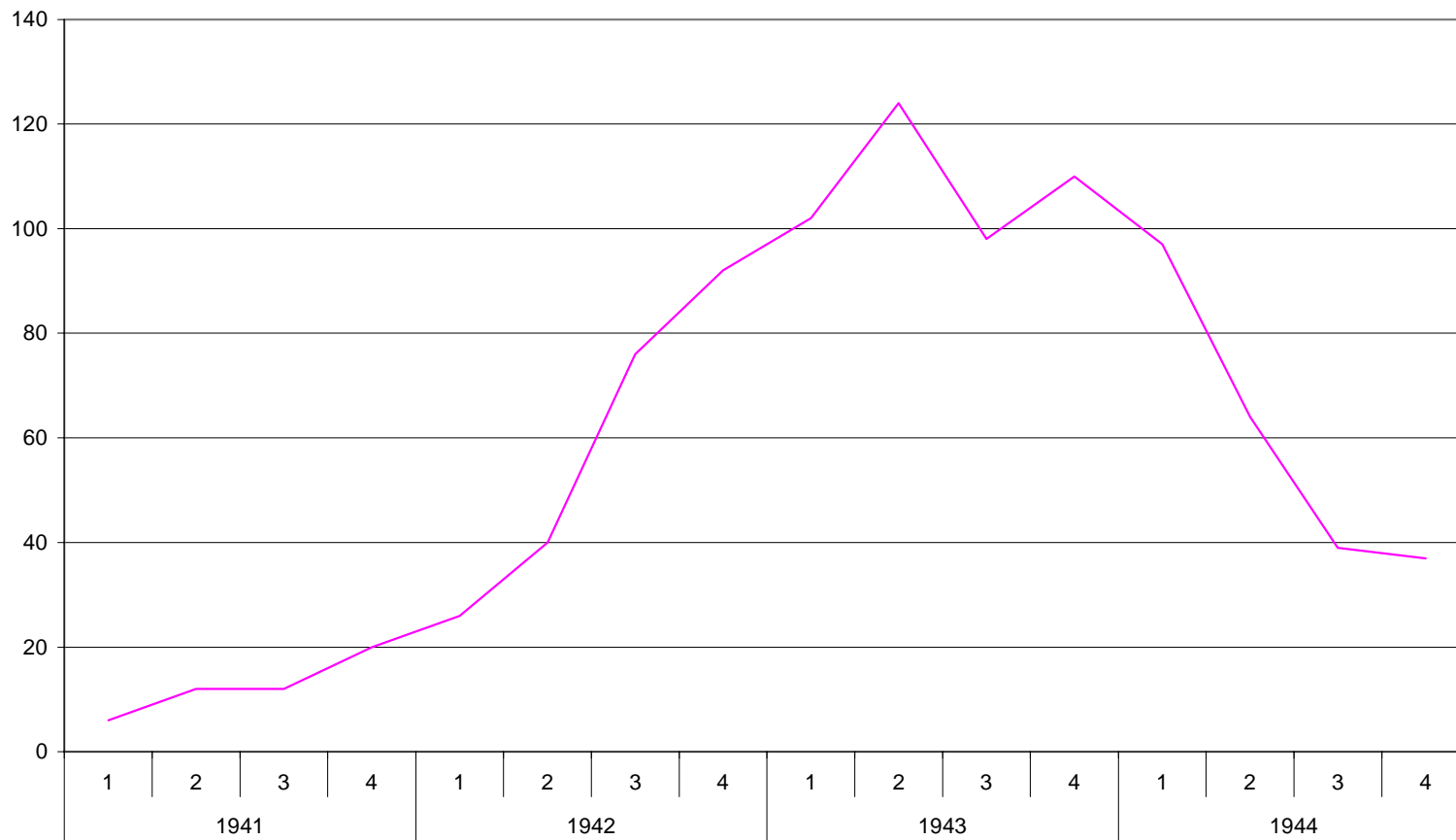


Figure 4
Average Output per Wolfram Mine
(Metric Tons of .65 - equivalent wolfram)

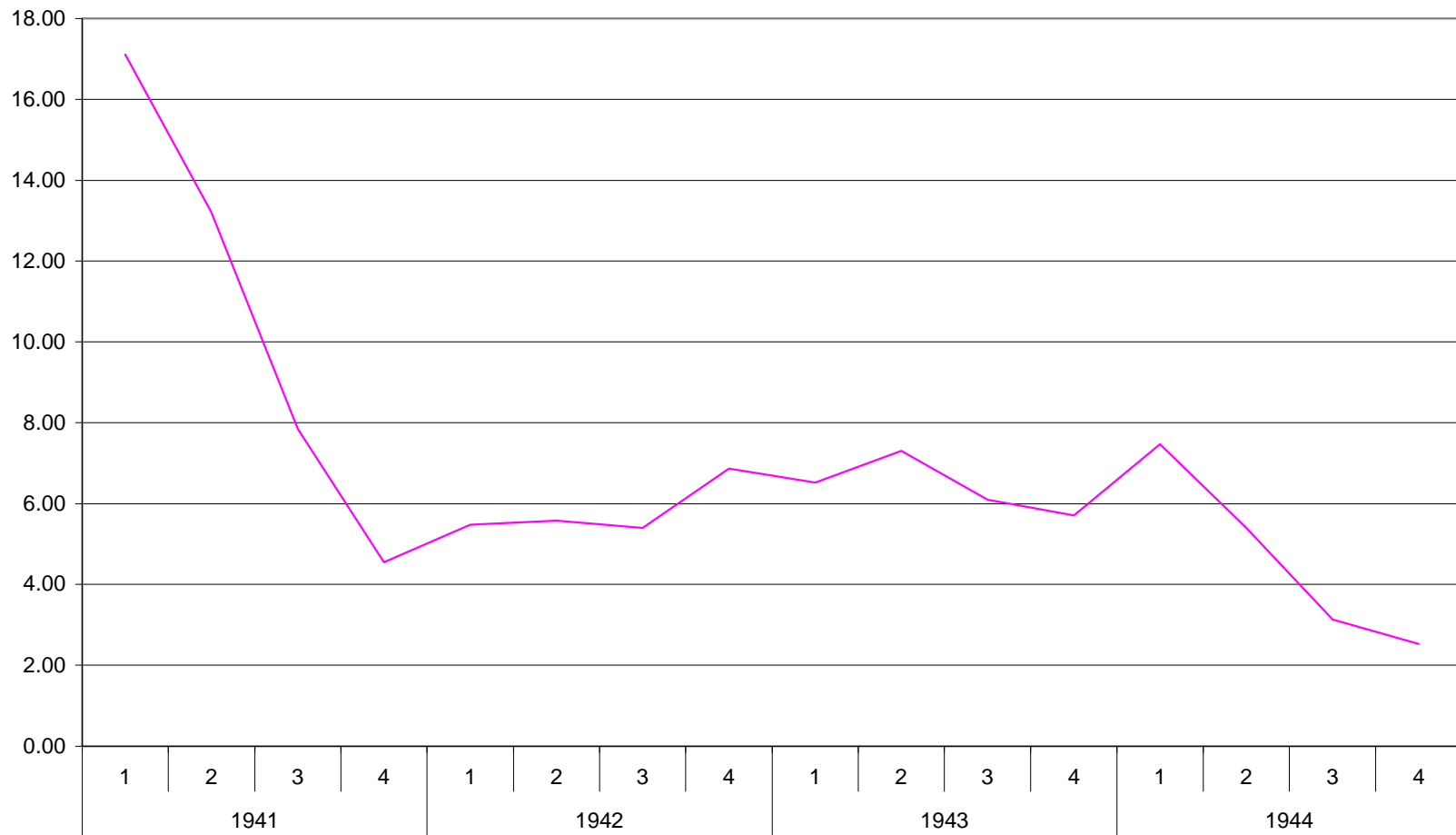


Figure 5
Percent of Tungsten in the Ore

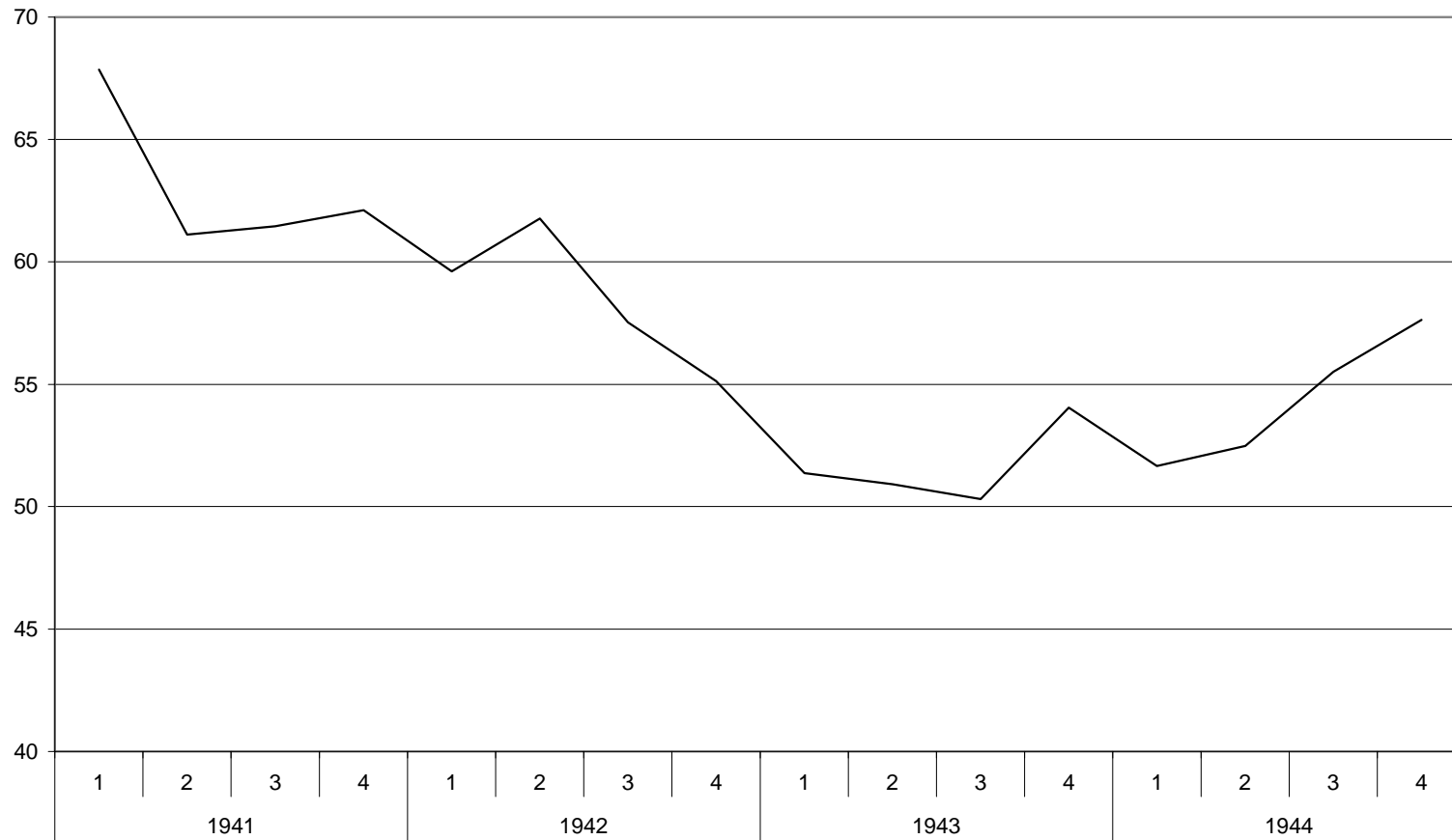
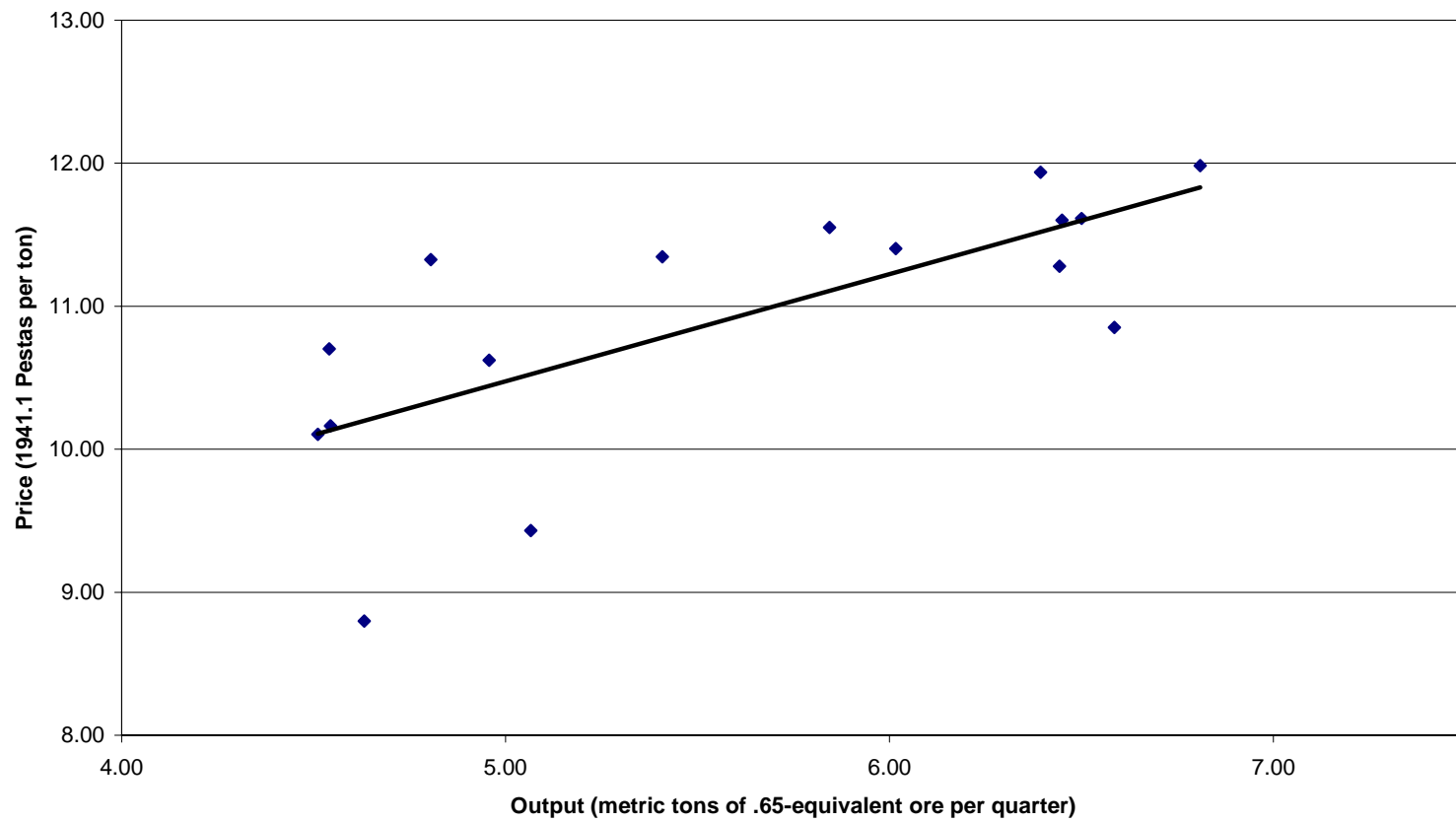


Figure 6
Price and Quantity of Wolfram
(Log Scale)



Chronology of U.S. Economic Warfare in Spain and Portugal		
1939	April 1	The Spanish Civil War ends with a victory for the Nationalists.
	May 19	Francisco Franco enters Madrid.
	September 1	Start of World War II (Germany attacks Poland)
	September 3	Britain imposes the Navicerts system through which Britain and the United States will regulate Spain's seaborne commerce.
1940	May 26 -June 4	Evacuation of British and French troops at Dunkirk. Germany gains control of Western Europe.
	June 10	Italy declares war.
	June 12	Spain declares "non-belligerency."
	June 14	Spanish troops occupy the International Zone of Tangier threatening British access to the Mediterranean.
	June 19	Spain offers to join Hitler's war against Britain in exchange for economic aid and territories in North Africa.
	July 27 - September 7	The First Oil Embargo. Britain and the United States cut all shipments of oil to Spain.
	September 7	Spain requests a loan from the United States.
	October 23	Franco and Hitler meet at Hendaye. Spain renews its demands for all of French Morocco and economic aid in exchange for joining the war.
1941	July	Spain agrees to end the use of the Canary Islands as bases for supplying German U-boats.
1942	January 24	Germany signs an agreement with Portugal under which Germany will get half of Portugal's "free" wolfram.

	February	The United States begins to buy Spanish Wolfram to keep it out of German hands.
	March 26	United States Commercial Company created to buy wolfram and other war materials.
	November 7	The Allies land in North Africa (Operation Torch). Spanish neutrality is respected, but fears arise in Spain that the Allies may choose to reenter Europe through Spain.
1943	January 7	Spain announces an increase in the export tax on wolfram from \$5,000 to \$15,000 per ton. The increase is later scaled back to \$10,000.
	August 2	Spain withdraws the Blue Division from the Eastern Front, although an element, the Blue Legion, remains behind.
	August 28	Spain and Germany agree on a cancellation of the Spanish Civil war debt, and a transfer of arms to Spain, in exchange for funds with which Germany can buy Wolfram.
1944	January 22 - May 2	Second Oil Embargo.
	May 2	The "May Agreement." Spain agrees to restrict the export of wolfram to Germany, and to make other concessions.
	August	German troops leave the Spanish frontier.

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Endnotes

* We would like to thank Robert Alexander for comments on a earlier draft.

1. This section is based primarily on Caruana (1999).
2. Although its status was unclear, Tangier at the time was an "international" city under Spanish, French, and British administration.
3. State Department. Foreign Affairs, West Europe, microfilm 1244-1.
4. The best known use of economic sanctions during the 1930s was the failed attempt by the League of Nations to force Italy to withdraw from Ethiopia. Ristuccia (2000), however, argues convincingly that if the sanctions had included an oil embargo, even one that kept U.S. sales to Italy at their peacetime level, they would have had a good chance of being successful. On the actual sanctions and their effect see Curovic (1997).
5. Sergio Ricorsa, using data developed by the Istituto Centrale di Statistica y del ISCO (Quadri della Contabilit  p.4), estimates that in 1940 Italian real income was 123.7 percent of the 1913 level and that in 1945 it was 62.4 percent.
6. At the time "wolfram" often was used as a synonym for tungsten. Here we use it as the name for the type of ore mined in Spain and Portugal.
7. There was also a bureaucratic reason. Preclusive buying was run by the Bureau of Economic Warfare. This agency, initially run by Henry Wallace, was only loosely controlled by the Department of State, and was conducting similar buying campaigns in other parts of the world.
8. Prices were calculated by dividing the total value of ore produced in all mines by total tungsten content of the ore (the sum over all mines of their output multiplied by the tungsten content of their ore), and multiplying by .65. We then deflated by the cost of living index set to 100 in the first quarter of 1941. Each mine also reported a price. In a number of cases price times quantity differed from total value, possibly because of recording errors, and possibly because the price represented a modal price, or something similar. The weighted average of these prices, however, is quite similar to the price that we use.
9. There are prices for individual months scattered through the literature. In particular Leitz (1996, 181) cites a number of prices for individual months. In fact, these prices generally agree quite closely with ours (they are generally within one or two percent) once allowance is made for the export tax. (Our prices are pre-tax). This is somewhat surprising because our prices are from a completely different source. The one exception is late in 1944. The value in our series is \$7,691 for the third quarter of 1944 and \$4,922 for the fourth quarter. Leitz gives \$1,826 for September 1944. The sample by this point is small, and some mines are reporting very low prices and sales,

similar to Leitz's figure.

10. Although Allied pressure to cut off exports grew as D-day approached, the exact timing was a coincidence. (Sweeney 1974).

11. For Portugal the end of the wolfram trade meant losses of more than \$8,000,000 per year, and unemployment of 90,000 to 100,000 persons. But, of course, it was only a matter of time until the war ended, and with it the extraordinary demand for wolfram.

12. The official exchange rate, at which foreign governments bought pesetas, was 10.95 pesetas per dollar. There was also an active black market in Tangier. The black market rate was considerably higher: 1941, 21.49 pesetas per dollar; 1942, 14.99; 1943, 13.25; and 1944, 15.21. Aceña (1989, 391).

13. Sofindus had been organized during the Civil War with the idea of converting Spain into a supplier of raw materials, especially metals, for Germany. Wolfram, however, was not a major focus of attention.

14. Arriba, August 15, p. 42. In the September 17, 1940 issue of the same newspaper he said: "The Empire that we announce as our political purpose can not be done alone, it must be done with others," a clear reference to the Germans.

15. Feis (1947, 221); Foreign Commerce Weekly, vols. 9-10, 18-19.

16. Whether it was wise to abandon the market at the same time the German's did is debatable. Had Allied purchasing continued, it might have discouraged the Spanish from making the deal that they did make with the Germans, and might have prevented the Germans from buying wolfram at depressed prices when they reentered the market.

17. At one point there were plans to purchase Spanish rabbit fur in order to preempt the Germans, who needed warm clothes for the eastern front. The plan was abandoned, however, when it was realized that the supply of rabbits indeed might be perfectly elastic.

18. Kemler (1949) provides a good physical description of the mining boom. Kemler served on the staff of the United States Commercial Company, and at the U.S. embassies in Lisbon and Madrid.

19. These are mines registered with the government. Some report no sales of wolfram during certain quarters.

20. First differencing solved the serial correlation problem, but the resulting coefficients did not seem reasonable. In the future, we hope to re-estimate the regressions taking into account the separate data on each province, and possibly each mine. This may yield more reliable estimates.

21. Feis (1947, 255-261) and Leitz (1996, 189-193). Cortada (1971), who did not have access to the German and Spanish document speculates that smuggling was limited.