Institutional Shocks and TFP Growth, Portugal, 1950s-1973

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Introduction

Economic growth in Portugal between 1953 and 1973 is essentially explained by the accumulation of factors of production (in particular physical and human capital). As time went on, however, increased efficiency in their use claimed a growing share in that explanation (Amaral, 2002). The process of growth of the Portuguese economy, therefore, changed in its nature, as, throughout time, the ability of economic agents to fast accumulate factors of production was complemented with their ability to use those factors in a more efficient manner. In this article I try to explain why such a change occurred. The general line of that explanation is as follows: until the 1960s the *Estado Novo* (the regime then existing in Portugal) was able to offer the economy an institutional setting that (by providing protection of property rights) fostered agents to invest, although not in a particularly efficient way. Although protective of property rights, the mentioned institutional setting was also marked by a series of interventionist and discretionary mechanisms that hampered the efficiency of the economy. That changed in the 1960s, when Portugal joined EFTA, following which the government had largely to give up the use of those interventionist and discretionary tools. This allowed for increased efficiency of the economy.

In assessing this process I was led to deal with the famous TFPG controversy. Its crucial point is to know whether TFP can be seen as a reliable source of information on technical change and efficiency. Rodrik (1997a) and Hsieh (1997) believe it is not and, consequently, downplay the empirical value of TFP. Young (1993, 1994, 1998a and 1998b) and Krugman (1994) take precisely the opposite stance. An analysis of the Portuguese growth process in the light of Rodrik's (1997a) remarks made me lend credence to Young and Krugman's position, i.e. affirming the relevance of TFP as an empirical instrument, capable of giving much valuable information on the nature of growth processes.

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The remaining of this paper goes as follows. In the first section the details of the TFPG controversy are presented. In the second section the TFPG controversy is put in the context of economic growth in Portugal in the postwar period. In the third section I try to make clear the distinction between technical change and efficiency, and get to the conclusion that TFP is best seen as a measure of the latter rather than the former. In the fourth section I make a detailed description of the *Estado Novo*'s institutional setting and of its possible effects on the economy. In the fifth section I present a series of statistical tests that try to relate institutions, TFPG and institutional changes brought by the process of opening of the Portuguese economy in the 1960s. In the sixth and final section I discuss some of the consequences of the findings of this article for economic theory.

1. The TFPG controversy

Economic growth in East Asia in the last forty years of the twentieth century has given rise to an important controversy. The controversy deals with the nature of the growth process of the region and, in somewhat simplified terms, has put face-to-face two groups of authors, "accumulationists" vs. "assimilationists" (to use the expressions coined by Collins and Bosworth, 1996). Very roughly stated, accumulationists argue that East Asian economic growth was essentially a story of factor accumulation, more precisely of physical and human capital accumulation (cf. Young, 1993, 1994 and 1998b, Krugman, 1994, and Collins and Bosworth, 1996). Assimilationists, on the contrary, argue that the main source of growth in East Asia is increased efficiency in the use of the factors of production (World Bank, 1993, Krueger, 1995, Hsieh, 1997). An additional group of authors (and one that we may view as a special strand on the assimilationists' side) recognises *cum grano salis* that accumulation explains the largest part of growth in East Asia. In these authors' view, however, new capital goods embodied enough technical improvements to allow for a story that cannot be told simply as one of accumulation. With capital accumulation, new technology must have come too, so that East Asian economies, by increasing their capital-labour ratios, concomitantly improved efficiency (Nelson and Pack, 1995 and Rodrik, 1997a).

The controversy is based on questions of both measurement and theory. Its starting point is the growth-accounting calculations of Young (1994) and Collins and Bosworth

(1996). The growth-accounting technique is a source of very important preliminary information for particular growth processes, since it allows for the decomposition of output growth into growth of inputs and of the residual (TFP). Interpretation of TFP is not straightforward. Strictly speaking, TFP is the productivity of all the factors of production. Some authors, however, identify it simply with technical progress, whilst others give it a broader significance, by identifying it with the more general concept of efficiency of the economy (see Griliches, 1996). I prefer the second meaning, and the reasons for this will become clear below.

In assessing the growth trajectories of the East Asian economies, both Young (1994) and Collins and Bosworth (1996) find that, once the contributions of physical and human capital are accounted, little room is left for TFP growth. This allows them to state, hence, that factor accumulation explains the largest share of the growth of those economies, increased efficiency in the use of the factors being of much lesser relevance. To understand the main point of the argument that follows it must be remembered that the contribution of the factors of production to output growth depends on two elements: growth of the factor itself, and the weight used to transform that growth into output growth. A high weight has a transformation effect of input growth into output growth that is stronger than a low weight. Now, Rodrik (1997a) argues that the weighting coefficients in growth accounting include by definition some contribution of technical change. To be more precise, Rodrik (1997a), following Diamond, McFadden and Rodriguez (1978), argues that the behaviour of the share of capital (the coefficient used to weight the contribution of physical capital to output growth) is dependent on three elements: the elasticity of substitution between capital and labour, bias in technical change, and the growth of the capital-labour ratio.[1] In more formal terms:

$$\dot{\alpha} = \frac{1-\sigma}{\sigma}(1-\alpha)\left[\left(\dot{a}_L - \dot{a}_K\right) - \left(\dot{k} - \dot{l}\right)\right] \qquad (1)$$

where α is the share of capital in national income, σ denotes the elasticity of substitution between the two factors of production, a_L and a_K are the labour- and capital-

[1] In order to simplify the presentation of the problem I will omit human capital from the following analysis.

augmentation coefficients respectively, and k and l are capital and labour (and a dot represents growth). Most importantly, Diamond, McFadden and Rodriguez (1978) show that, given certain observed input and factor share series, it is empirically impossible to identify separately the underlying cause of the behaviour of the share. That is, it is impossible to know if that behaviour was caused by the elasticity of substitution between the factors or by the bias in technical change.

Since the share of capital in East Asian economies remained high throughout the 1960s to 1990s period, Rodrik (1997a) argues that that may have happened either thanks to a high elasticity of substitution or an increase in labour-augmenting technical change ($\dot{a}_L$). Since not only growth in physical capital was very strong in all of the East Asian economies, but also they all kept a high capital share, it is not surprising that once the contribution of factors is accounted, the role of TFP is so insignificant. Rodrik's (1997a) argument, however, is that Young (1994) and Collins and Bosworth (1996) may (erroneously) be attributing low TFP growth to weak technical change. According to Rodrik, the share of capital remained high most probably because physical capital embodied enough labour-augmenting technical change. To put things more clearly, with such strong growth of physical capital, one would expect in due time a decrease in the marginal product of capital or, which is the same, of the share of the factor in national income (α). The decrease, however, did not occur. There are only two possibilities capable of explaining such fact in Rodrik's (1997a) view: either the substitutability between factors was high, or labour-augmenting technical change was significantly introduced in the economy. Rodrik (1997a) clearly does not believe in a high elasticity of substitution. In his own words, "we would have to place very strong priors on the likelihood that $\sigma = 1$, or on the Hicks-neutrality of technical change, in order to be able to rule out a significant amount of labour-saving technical change" (Rodrik, 1997a).

Rodrik's (1997a) argument has more than simple empirical consequences. If it is true that factor shares also reflect technical change, then TFP may indeed be useless as a measure of technical change and of the efficiency of an economy. If what one is supposed to measure by the residual is already being measured by the contribution of the factors of production, then TFP must be little more than a simple index storing all measurement errors of growth-accounting.

2. Factor accumulation and TFPG in Portugal in the post-war period

Table I reports the results of a growth account for the Portuguese economy between the 1950s and 1973. If the 1953-1973 period is seen in its entirety, TFP was the second most important source of growth of the economy (just behind physical capital) contributing with around 43% to its growth rate. But if we break down the full period into three sub-periods (1953-1959, 1960-1964 and 1965-1973), we can see that the contribution of TFP increased with time, with a sudden shock from 1960 on. In the first period its contribution was third, behind those of both physical and human capital, with around 9%. In the following period, it increased significantly (to around 50%), and in the third period, despite a mild decline, it remained at a very high level (roughly 44%).

Interpretation of these figures in the light of Rodrik's (1997a) remarks should begin by a check on the possibility of the result having been partially due to a decline in the share of capital. As a matter of simple arithmetic, if the share of capital declined and the capital-labour ratio kept on growing, then more room must have been created for TFPG. Table II and Figure 1, which provide figures for the evolution of that share, show that it did indeed decline. While it was roughly stable for the full 1953-1965 period (despite some fluctuations), it declined consistently from then until the end of the period. Such decline implies in growth-accounting calculations a decrease in the weighting coefficient of capital, thus making it contribute less to the growth of the economy while increasing the importance of TFP. According to Rodrik (1997a), and in terms of equation (1), the decline in the capital share could only have been caused either by a decrease in the substitutability of factors or a decrease in labour-saving technical change. In the following paragraphs I will try to contest this conclusion, by proposing an alternative cause for the movement of the capital share. Given that it is empirically impossible to identify the underlying cause of that movement, I will not be able to give any definite conclusion. The procedure must be a stepwise one, positing plausible although unobservable alternatives.

Let us consider each of the two possibilities put forth by Rodrik (1997a) in turn. Why would the elasticity of substitution decline brusquely from the 1960s on? What the elasticity of substitution measures, put in simple terms, is the willingness of economic

agents to substitute one factor with the other when the price of the first factor declines in relation with the price of the second. Let us suppose the marginal rate of technical substitution declined, i.e. the price of capital declined in relation with the price of labour. If the elasticity of substitution were high, then economic agents would strongly substitute labour with capital. If it were low, that substitution would be much less significant.

Why would, then, economic agents reveal from the 1960s on less willingness to substitute labour with capital? The first thing we must know is if there was a decline in the capital-labour ratio. Table III shows that there was not. Quite on the contrary, the period of stronger decline in the share of capital was also the one of stronger growth of K/L. What may have happened, hence, was not that economic agents were not willing to substitute labour with capital, but rather that they were proportionally less willing to do so when the relative price of the two factors changed. That is, other things being equal, if the elasticity of substitution were higher than it possibly was, they would have substituted more of one factor with the other. The only possibility for a probable sudden decline in the elasticity of substitution (if we rule out a simple random change in the behaviour of economic agents) is that the technology embodied in the new capital goods was less favourable to the substitution of labour with capital. Was there in the 1960s some technological breakthrough that would explain that? This would, of course, require a more detailed investigation. But that does not seem to be a very strong bet. The hypothesis of a sudden change in substitutability of factors of production does not seem, thus, to be a particularly plausible one.

The other possibility Rodrik (1997a) would posit in the face of such facts is a decline in the introduction of labour-saving technical change. Again, what plausibility has this hypothesis? Although we cannot entirely rule it out, the data seem to suggest that, if anything, as the capital-labour ratio increased so would embodied labour-saving technical change increase too. That, of course, also runs counter Rodrik's (1997a) hypothesis.

Let me, then, suggest an alternative hypothesis. In addition to elasticity of substitution, the growth of the capital-labour ratio, and the growth of the a_L parameter, equation (1) presents one further parameter of which Rodrik (1997a) does not make a single mention. That is the a_K parameter. In terms of equation (1) the share of capital can decline not only because of the reasons given by Rodrik (1997a) but also because of an

increase in capital-augmenting or capital-saving technical change. What if capital began to be used more efficiently from the 1960s on than it did in the previous decade? The most straightforward way of measuring the efficiency in the use of capital is through the capital-output ratio. Table IV shows the growth rates of the capital-output ratio for the full 1953-1973 period and for the three sub-periods I have been considering in this article. The last sub-period (1966-1973) does show indeed an exceptional decline in the capital-output ratio, thus confirming the hypothesis of increased efficiency in capital use. But, if there are not very strong reasons to believe in a sudden decline in the introduction of labour-saving technical change, why should there be reasons to believe in a sudden increase in capital-saving technical change? It so happens that those reasons are quite plausible. In 1960 Portugal joined EFTA and opened its economic frontiers much significantly. Such openness must have had a significant impact in smoothening the inefficiencies typical of the institutional setting of the *Estado Novo*. By joining EFTA Portugal made most of the protectionist paraphernalia inherited from the 1930s and the Second World War recede to practically residual levels. Furthermore, openness broke the stringency of industrial conditioning rules and subjected Portuguese entrepreneurs to a much more dynamic competitive environment. This must have led them to select investment outlays much more cautiously then before, thus increasing efficiency in capital use. I will come back later to this problem.

This has very important implications for the interpretation of TFP. Remember what TFP stands for - total factor productivity, i.e. the efficiency with which *all* factors of production are used in an economy. Technical change can indeed be introduced in an economy, for instance by capital deepening (as long as capital embodies new technology) and still not be used in an efficient manner. That is because capital may be accumulated at a fast pace (thus saving labour) without great concern for efficiency in its use (thus wasting capital). This re-instates TFP as a good approximation to the problem of efficiency, as opposed to the problem of technical change. The latter may indeed increase the efficiency with which one of the factors is used, but not necessarily of all the factors.

All this seems to lend credence to the accumulationists' view of growth in East Asia. That is, if we still believe that TFP is a good measure of efficiency, independently of the fact that capital accumulation is also a carrier of technology, then growth in East

Asia can still be mainly seen as a story of factor accumulation. Those economies grew due to their ability to accumulate physical and human capital at a fast pace and not because of their ability to do so in an efficient way. Something in the environment of the growth experiences of East Asia was missing in order for the factors of production to be used more efficiently than they actually were.

The interpretation of TFP adopted here also allows for a refinement in the assessment of the Portuguese growth experience in the post-war period. What the data presented above show is that growth in Portugal can be divided into two essential periods. One in which Portugal followed a mostly accumulationist path, until the early-1960s, and another one where it started following a more assimilationist path, from then on. In the next sections I will precisely try to understand what conditions determined the differing behaviour in each of the periods. That is, what allowed for fast accumulation and low efficiency in the 1950s, and for higher efficiency in the 1960s and early-1970s.

3. TFP, technology and efficiency

As a first step in trying to understand the increased contribution of TFPG to economic growth in Portugal from the 1960s on I will relate it with some data that are sometimes seen as direct measures of technical change. If it were somehow possible to make TFP correspond to some directly measurable quantity or data, we would have come a long way to understand what drives growth beyond factor accumulation.

In Romer (1986) technical progress (or new knowledge, in the own words of that author) is a by-product of investment. By investing, and thanks to a learning-by-doing process, firms increase the stock of knowledge in the economy. If that is so, and if TFP equals technical progress, one should expect a significant relationship between TFP and investment. Below I will test this possibility directly.

In Romer (1990) new knowledge comes about thanks to direct research efforts by firms (be they exclusively or only partially dedicated to research). This has led that author to suggest that both patent registration and R&D expenditures could be good empirical approximations to technical progress. Both sorts of indicators have serious problems as empirical proxies for knowledge. On the one hand, knowledge may be introduced without big R&D efforts, namely if most of it is imported, or if sophisticated methods of blueprint

copying are developed. Furthermore, R&D figures are simply input figures, unable to account for the results obtained. R&D is a search process whose outcome is largely uncertain. This means that R&D expenditures can be more or less productive, so that lower R&D expenditures can generate more technical change than higher ones. R&D figures cannot, hence, possibly constitute a constant yardstick for the measurement of technical progress (for all these problems, see Griliches, 1994, and Verspagen, 1996). Of course, and coming to the other indicator, patent registration can be seen as a measure of the output of R&D efforts. Patents as a proxy for technical progress have problems of their own, however. Some technologies are more patentable than others, and patent offices are themselves subject to productivity and bureaucratic cycles (depending on the quality of the personnel employed, the complexity of the new technology or the budget available, see Griliches, 1989 and 1990). Still, short of something else, data on patents and R&D can be tentatively used in order to approximate the problem of technical change in an economy.

In one further model (Barro and Sala-i-Martin, 1995b) technical progress in less advanced countries is a result of imitation of technical progress generated in more advanced countries. This also poses data problems, for it is difficult to find an empirical instrument that can capture this sort of process. The number of foreign patents registered in the country is of course a possibility.

How well do the mentioned indicators capture the increased efficiency of the Portuguese economy from the 1960s on? Figure 2 shows the number of patents registered in Portugal from 1951 to 1972. There seems to be a quite consistent rate of growth of patent concession in Portugal until the late-1960s, with a sudden acceleration from then on until 1971, followed by a reversion to trend in the final year of the series. The figures, however, should be disaggregated into the national and the foreign components. Most of the behaviour of the series clearly seems to depend on the number of foreign patents registered in the country, whilst the number of Portuguese patents not only is consistently lower than that of foreign patents but also does not present any growing trend.

Figures on R&D expenditures in Portugal are very poor, and thus of little help in our enquiry. There are only figures for four years, 1964, 1967, 1971 and 1972, none allowing, thus, for a comparison with the 1950s. They show (Table V), nevertheless, a

very low R&D intensity for the country in the 1960s and early-1970s, despite some growth. What is more, in comparative terms, as shown in Table VI, Portugal was the country that, together with Spain, devoted less resources to R&D in this period.

In this article I will propose one further possible explanation of TFPG. And that explanation relates to the institutional environment economic agents faced. Unfortunately, there is no theoretically explicit way of connecting institutions and TFP, but I will suggest some possible paths to explore. Before doing that, however, I must briefly review the evolution of the main institutional features in Portugal in the period under study.

4. The institutional evolution

I have shown elsewhere that the *Estado Novo* provided an institutional setting that brought confidence to investors (Amaral, 2002, see also Dias, 2001). The *Estado Novo* was an authoritarian regime, but one that, however, and contrarily to Italian and German fascism, was relatively moderate in its features. Contrary to fascism, the *Estado Novo* institutionalised a political situation where the rule of law essentially prevailed. State violence was undoubtedly present, but was subject to institutional norms, making it, thus, predictable and used only selectively and parsimoniously. The *Estado Novo* was not an arbitrary regime, being actually founded on largely liberal principles, so that it can even be seen as a sort of adulterated, truncated and authoritarian offshoot of liberalism. Additionally, the regime complemented that institutional setting with an educational policy that helped to unlock the potential for growth in schooling.

This (together with other complementary institutional features of the regime) created an environment much favourable to growth in investment. Such growth brought strong capital accumulation, which (together with education) was the main source of expansion of the economy in the 1950s. The institutional setting of the *Estado Novo* was, however, also marked by a series of bureaucratic barriers to the full functioning of markets. The part of the *Estado Novo*'s institutional setting that was favourable to enhance the investment potential of the country was related to budgetary and monetary matters (as well as to the general institutional environment). In both aspects the *Estado Novo* brought a trustworthy commitment to keep budgets consistently balanced and

subject money emission to a predictable rule. Both implied that entrepreneurs viewed the *Estado Novo* as an institutional setting that secured property rights, where their assets were not to be subject to sudden devaluation.

But there was also in this institutional setting an extreme regulation of markets. This was particularly true of the high trade barriers put in place in the 1930s and 1940s, of industrial conditioning and of administrative pricing. The latter did not have an exceptionally significant impact on the economy as a whole (although it had a significant impact on certain sectors) since it was largely an *ad hoc* and episodic phenomenon. But protectionism and industrial conditioning pervaded deeply the economy.

Contrary to a traditional belief in Portuguese historiography, the *Estado Novo*'s stance on foreign trade was not autarkic, but rather of moderate protectionism (or, put in reverse, of moderate liberalism). This did not mean, however, that Portugal did not participate in the protectionist tide of the 1930s. So, as in all other European countries, at the end of the Second World War numerous barriers hampered foreign trade in Portugal. Such barriers naturally had created vast market distortions in the two previous decades.

Market distortions were also very serious in the case of the manufacturing licensing scheme named industrial conditioning. Industrial conditioning forced potential investors to submit their projects to a much-detailed bureaucratic procedure. Projects had to be evaluated by the government, which also consulted with already installed firms before reaching a final decision on licensing. Industrial conditioning had, thus, a strong impact on investment allocation. Since firms were installed not entirely according to what agents felt were market needs, but also according to what the government thought were national needs, numerous inefficiencies arose.

This means that, whilst entrepreneurs felt secure about their property rights, which led them to invest at increased rates, they were also subject to regulations that constrained their freedom in investment allocation. The hypothesis put forth in this article is that openness after adhesion to EFTA in 1960 limited to a great extent the grip of the state over economic activity, and that that had a reflection on the efficiency of the economy, as measured by TFP growth.

Figures 3 and 4 show two measures of the growing importance of trade for the economy. On the one hand, the volume of trade increased significantly throughout the

period, with a shock occurring after 1960 (Figure 3). On the other, the share of trade in national wealth also increased significantly, from around 20% in 1930 to close to 50% in 1973. Also to note here are one shock in openness after 1945, and another one, followed by a steeper trend, after the late-1950s/early-1960s. It must be said that openness of the Portuguese economy did not start in 1960. Since the end of the Second World War that Portugal, by participating in OEEC (1948) had been forced to dismantle most of quantitative restrictions to trade. But these previous episodes had simply affected the most absurd aspects of the protectionist paraphernalia inherited from the heyday of protectionism in the 1930s and 1940s. 1960 brought for Portugal the most significant blow to protectionism, when the country joined EFTA. Only from then on can we say that Portugal (and all other countries participating in EFTA and EEC) entered a new openness age.

What is more, adhesion to EFTA forced Portuguese authorities to change some of the most efficiency-hampering aspects of the then existing institutional framework. Industrial conditioning suffered a most important blow. It was of course absurd to force Portuguese firms to compete with firms of more developed foreign countries while still subjecting them to the extraordinary bureaucratic intricacies of industrial conditioning. The rules of this licensing scheme thus changed in 1965. From then on, industrial conditioning became more of an abstract and technical procedure, loosing the most serious of its previous arbitrary aspects. From 1965 onwards it was simply necessary that the project presented possess certain general technical requirements for the government to license it (cf. Brito, 1989 and 1996; Confraria, 1992 and 1999; Lopes, 1996). This was, of course, still short of total liberalisation, but it came a long way towards a more neutral role for the government.

Rules concerning foreign investment were also affected after adhesion to EFTA. In 1965 Portugal signed the OECD's Code for the Liberalisation of Capital Movements, and in 1965 a new law liberalising capital movements was enacted (Simões, 1985). This must have had a significant impact on the economy's efficiency, foreign investment being an important carrier of new technology. Foreign investment data are only available from 1965 onwards. The existing data are given in Table VII, and show that foreign investment (FDI and portfolio investment put together) kept their relative importance as a percentage

of total investment from 1965 to 1973. It is not possible to establish any conclusion, with such scant data, on the medium- to long-run relationship between foreign investment and the economy, mostly in comparison with the 1950s.

5. Institutions, investment and efficiency

Next I will try to test formally for a relationship between TFP growth and the indicators mentioned above, namely investment and patent concession, plus an indicator for increased connection of the economy with the world market. The R&D series is too short and discontinuous to allow for any formal test. The particular statistical test chosen for this purpose was cointegration. The first step involved here was to test for the degree of integration of the various series. The series used were the TFP index as obtained in the growth account implemented in Amaral (2002), the series for investment, the series for the number of patents (at the aggregate level and separated for foreign and national) conceded in Portugal and the volume of foreign trade of the country (exports plus imports), all for the period 1953 to 1972. An Augmented Dickey-Fuller (ADF) test of the following form was implemented:

$$\Delta x_t = \alpha_0 + \beta_1 t + \beta_2 x_{t-1} + \sum_{i=2}^{p} \beta_3 \Delta x_{t-1+i} + e_t$$

where x_t is the series being tested, t is a trend term and e_t is an error term.

As reported in Table VIII, the tests showed that the TFP, aggregate patents, national patents and trade series contained one unit root, that is that they were integrated of order 1, but that both the investment and foreign patents series contained more than one unit root. This immediately excludes investment and foreign patents as candidates to explain the behaviour of TFP in a cointegration framework. A cointegration relationship is still possible, however, for the other series. The next step was, hence, to estimate a regular OLS equation of the following form:

$$TFP_t = \alpha_0 + \beta_1 PATSNAT_t + \beta_2 TRADE_t + e_t$$

where TFP_t is the TFP_t index, $PATSNAT_t$ is the national patents series, $TRADE_t$ is the foreign trade series and e_t is an error term.

The results are given in Table IX (row 1) and show the proper sign and a significant t-statistic for the trade variable, but the wrong sign and a non-significant t-statistic for the patents series. When restricted to the TFP and trade series, the test keeps on being supportive of a relationship between the two (row 2). The same does not occur, however, when the test is restricted to the TFP and patents series (row 3). Changing the order of the series keeps on supporting a relationship between TFP and trade, but not between TFP and patents (rows 4, 5, 6 and 7). The only robust result is, hence, the one relating the TFP and trade series. This is not, however, enough in itself to establish a long-run relationship between the variables. That can happen only if the residuals of the regressions are shown to be stationary. Table X shows the ADF results for the residuals. On the basis of these results it is possible to reject the null hypothesis that the residuals for both specifications contain a unit root, which means that they are stationary and, consequently, that the two series are cointegrated.

These results may put into question the whole empirical approach of trying to relate TFP with indicators for research. One cannot, of course, be completely assertive in this respect. It can be said for certain, nevertheless, that cointegration shows that patents are not a satisfactory part of the explanation of TFP growth in Portugal in the period under study. Foreign patents (as a proxy for imitation of foreign knowledge) are simply not of the same order of integration as TFP. This is an obvious challenge to Barro and Sala-i-Martin (1995b) suggestions. But also the number of national patents does not help to explain the behaviour of TFP, which challenges directly Romer (1990). This allows for two possible alternative conclusions. The first is that the number of patents (both national and foreign) conceded in this period is not a good proxy for technical progress. This is, of course, possible. There are so many problems with the variable, both as a measure in itself as well as an approximation to R&D output or even new technology, that it can indeed be that it does not capture what I am looking for. If this is the case, unfortunately there is little room for improvement, as there are no other candidates available for this period capable of replacing patents. The second possible conclusion is to acknowledge

that the variable is a good proxy for technical progress, but that it still is not enough to explain TFP growth.

Which brings us back to the problem of institutional shocks. A different research path is, thus, to ask, instead of trying to reduce innovation to a simple quantifiable variable, what environments are more favourable to spawn the creative potential of economic agents. As mentioned earlier, a most important event for the Portuguese economy was its increased connection to the world market from 1960 on. The hypothesis put forth here is that increased openness somehow limited the negative impact on economic performance of some of the institutional features of the *Estado Novo*. Whilst, as shown elsewhere (Amaral, 2002), the institutions of the *Estado Novo* as they were set up in the 1930s brought an environment that gave confidence to investors, they also had features marring the functioning of markets. The argument here is that increased openness limited to a significant extent the grip of these negative institutional elements over the creativity of economic agents.

This is where we must come back to Rodrik's (1997a) conclusions. The whole purpose of Rodrik's paper is to downplay TFP as a true measure of efficiency, in order to make growth mostly a story of investment and capital accumulation. By thus proceeding, Rodrik is able to re-instate governments as essential agents of growth. In Rodrik's view, the role of governments should not be simply that of getting the "fundamentals" right (keeping budgets balanced and inflation low), but also of "getting interventions right" (Rodrik, 1994). Rodrik's view of what happened in Taiwan, South Korea and Singapore (Hong Kong, significantly, does not enter his account) corresponds to governments identifying situations of co-ordination failure under de-centralised market conditions. Once those situations identified (Rodrik is mute on the means at hand of governments to spot market failures, a realm still obscure to professional economists but apparently not to East Asian rulers) governments not only removed some obstacles to investment, but also developed policy instruments to co-ordinate and subsidise investments, namely through credit subsidies, tax incentives, administrative guidance, and public investment (Rodrik, 1994). What is more, much of the success in East Asia would also have been related to a policy of selective nationalisation of certain sectors, as well as the provision of

guarantees that the government would bail out entrepreneurs investing in "desirable" activities (Rodrik, 1997b and 1999).

The story of Portuguese economic growth in the post-war period helps to put these ideas in perspective. After all, the Portuguese government seems to have followed an approach similar to the East Asian ones until the 1960s. Not only it provided protection of property rights (among other things by getting the fundamentals right) to economic agents, but it also used a series of discretionary methods to allocate investment according to what it thought were "desirable" sectors. Not surprisingly, growth in Portugal in that period was essentially of the accumulationist type. But from the 1960s on the story changed altogether. By joining a free trade area, the Portuguese government was forced to give up most of its discretionary and arbitrary instruments. The Portuguese economy became then subject to a much larger extent to market co-ordination rather than government co-ordination. Interestingly enough, the story of Portuguese growth departs from then on from the East Asian path, and approaches more an "assimilationist" path. By disrupting the government's grip over the economy, openness made the Portuguese economy much more dependent on market forces, thus offering it the opportunity to become much more efficient than before.

This leads to the conclusion that there may be growth stories (such as in the cases of South Korea, Taiwan, or Portugal until the 1960s) where governments can offer economic agents some basic institutional environment where property rights are secure and, hence, investment can expand. But where that institutional environment is accompanied by a set of arbitrary and discretionary government actions, it is probable that what one gets is an essentially "accumulationist" path of growth. Instead, where the same institutional environment is accompanied by de-regulation, neutral government action and increased reliance on market co-ordination (as in the case of Hong Kong and Portugal between 1960 and 1973), one gets a more efficient ("assimilationist") growth path. Physical and human capital accumulation cannot proceed forever, being eventually subject to decreasing returns. Only with increased efficiency can economies reach higher *sustained* growth paths. Perhaps the current economic woes of East Asia have something to do with this.

6. The results of this article and growth theory

Various points that were discussed in this article have implications for the robustness of growth theory and its empirical tractability. The basic neoclassical Solow model deals with technical progress by defining it as an exogenous good that is provided to the economy in an unspecified way. Technology simply pours the economy, without being explicitly provided by any one particular agent. Since private agents do not provide it, and everybody benefits from it, it can be seen as a public good that becomes freely available to all agents. It has no costs (private or public) and its generation does not give rise to private profit. This vision, even if one allows for a certain ability of the general model to describe some aspects of growth, certainly lacks conceptual robustness.

In this sense, Romer's (1986, 1990 and 1994) alternative formulations of technical progress are conceptually more interesting. By being provided through private investment (Romer, 1986) or dedicated research (Romer, 1990), technical progress still conforms to the nature of public goods (being thus available to everyone at no cost, as in the Solow model), but one that is privately provided. Knowledge, contrarily to a pure public good, is non-rival but can be partially excludable, either through the patent system or certain features of firms' structure. Although a public good, it is provided by private agents that incur costs, get a return and profit from it.

In the Solow model there is no explicit empirical counterpart for technical progress, which is understandable, since no one exactly knows what it is. But Romer suggests for his framework the use of figures for R&D. As shown above, however, there is no reason, for the Portuguese case at least, to believe that R&D efforts are a satisfactory explanation of the growth in efficiency of the economy. Of course, data for Portugal are of extreme low quality and the statistical tests that were performed above must have been seriously affected by that problem. Still, similar conclusions have been reached for the United States' economy for the twentieth century, a context much less haunted by the same sort of problem (Jones, 1995). This, of course, raises questions not only as of the empirical tractability of Romer's models, but also of their theoretical validity. If there is more to growth (in particular in what refers to efficiency) than research, the theory is flawed and subject to the criticism of being incomplete.

The suggestion of this article is that there is something to institutions that must help to understand why economies can become more or less efficient. In particular I suggested that the opening of the Portuguese economy in the 1960s gave it an efficiency shock. According to what was proposed above adhesion to EFTA in 1960 limited the grip of the state over economic activity, namely by eroding the discretionary power it had over the functioning of various markets. The question is, of course, how to model this sort of problem in a theoretically relevant way. One first step could be to avoid defining institutional shocks in the same manner that technical progress is defined in the various growth models, i.e. as a public good. Not everyone benefits in the same manner from an institutional shock as the one presented above. Some agents are more able than others to grasp new opportunities. What is required of an entrepreneur in the context of an open economy may be different from what is required of an entrepreneur in a more tightly regulated economy.

One tentative possibility, then, to model the sort of institutional shock defined above, is to start by a microeconomic approach where there are two sorts of firms, those relying mostly on capital in their productive processes, and those relying mostly on technical progress. Then the institutional setting prior to the openness shock could be seen as one whose effect was to subsidise capital accumulation and tax technical progress. This makes sense because (taking Portugal as an example) the Portuguese institutional setting was protective of property rights and of investment, but did not let the market work in the selection of more or less efficient firms. This changed when the economy opened, since it was no longer possible for the government to use the same sort of regulation as before. The new institutional context can be then modelled as one that no longer taxes technical progress.

There is one further serious problem in connecting the empirical findings of this article with growth theory. The possibility posited above was that the openness shock of the 1960s changed the nature of technical progress, by making it capital augmenting rather than labour augmenting. Now, this contradicts existing theory. All models (from Solow to Romer) contain a steady state, and in models with a steady state, technology (for reasons of mathematical modelling) must be of the labour-augmenting kind (see Solow, 1969 and Barro and Sala-i-Martin, 1995a). When that does not happen, a steady

state does not exist and the whole theoretical foundations of the models become unsustainable. The question is: is this a serious enough problem to lead economists to invest more time and talent in finding ways of modelling technical progress otherwise, or is this simply a minor inconvenience brought about by theoretical simplification, and one that can be kept in the name of the fact that, still, the existing theory is rich enough to help us understand reality?

Conclusion

To sum up, Portuguese economic growth in the post-war period can be divided into two sub-periods. One, which occupies the 1950s, is marked by strong factor accumulation and relatively low TFPG. Another one, which occupies the 1960s and early-1970s, is marked by both strong factor accumulation and fast TFPG. The reasons for such differing behaviour are that, in the first sub-period, although the institutional setting of the *Estado Novo* was favourable to factor accumulation, it also introduced a series of distortions in the use of factors of production that generated a relatively low efficiency for the economy. In the second sub-period, on the contrary, that institutional setting received an openness shock that disrupted most of its efficiency-hampering elements.

This allowed me to contradict some of the most important of Rodrik's (1994, 1997b and 1999) conclusions concerning the role of governments in economic growth. Whilst for that author governments must not limit their action to getting the fundamentals right, but also fulfil the essential role of identifying and solving market failures, I propose that their role must precisely be limited to the first task. When governments tread beyond that (namely by trying to identify and solve market failures) they introduce distortions in the economy that in time they must eventually pay. Although such interventions can help or foster factor accumulation in a way that leads economies to grow fast along a certain growth path, they are a source of inefficiency whose price is the inability of the same economies to push outward that same growth path. The Portuguese case, precisely, illustrates this point. In the 1950s the role of market co-ordination was partly fulfilled by government co-ordination, and the result was low efficiency as measured by TFP. In the 1960s, on the contrary, market co-ordination progressively replaced government co-

ordination, and that fostered a more efficient behaviour of economic agents in their use of factors of production.

Table I
Rates of Growth of GDP and of the Sources of Economic Growth, and Contribution to Economic Growth (%)

	GDP growth	RL growth	% of GDP growth	HK growth	% of GDP growth	K growth	% of GDP growth	TFP growth	% of GDP growth
1953-1973	5.61	-0.20	-3.62	0.96	17.04	2.45	43.65	2.41	42.93
1953-1959	4.32	-0.35	-8.10	2.33	53,94	1.96	45.37	0.38	8.80
1960-1964	5.81	-0.17	-2.93	0.52	8.95	2.63	45.27	2.83	48.71
1965-1973	6.16	-0.12	-1.95	0.90	14.61	2.70	43.83	2.68	43.51

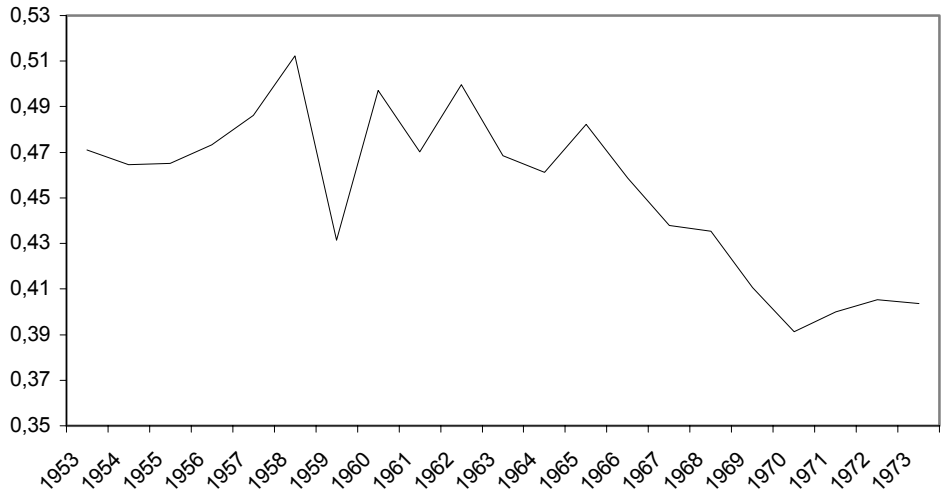
Source: Amaral (2002)

Table II
Capital share, Portugal (1953-1973)

1953	0,471
1960	0,497
1965	0,482
1970	0,391
1973	0,404

Source: Pinheiro (1997)

Figure 1
Evolution of the share of capital, Portugal (1953-1973)



Source: Table II

Table III
Rate of growth of the capital-labour ratio, Portugal (1953-1973)

1953-1973	4.82
1953-1958	3.13
1959-1965	5.00
1966-1973	5.67

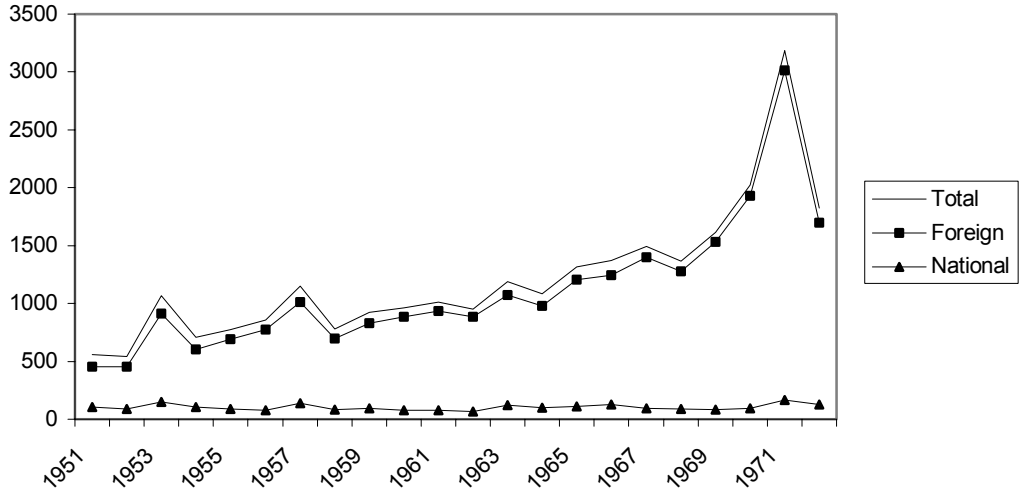
Source: Author's calculations based on Pinheiro (1997)

Table IV
Rate of growth of the capital-output ratio, Portugal (1953-1973)

1953-1973	-3.10
1953-1958	-1.84
1959-1965	-2.00
1966-1973	-5.70

Source: Author's calculations based on Pinheiro (1997)

Figure 2
Patents conceded in Portugal, 1951-1972



Source: Ministério das Obras Públicas, Comércio e Indústria (1951-1972)

Table V
R&D expenditures in Portugal (million current *escudos*)

	R&D	**R&D/GDP**
1964	265.8	0.0029
1967	320.4	0.0027
1971	751.2	0.0038
1972	854.2	0.0037

Source: Caramona (1972) and Pinheiro (1997)

Table VI
R&D intensities (R&D expenditures as a fraction of GDP), various years, OECD

	1963	1967	1970
USA			0.027
Germany	0.014*	0.018	0.021
Japan	0.015	0.016	0.018
Switzerland	0.025	0.024	0.023
France	0.016	0.021	0.019
Netherlands	0.019*		0.020
Belgium	0.010	0.013	0.014*
Norway			0.011
Finland			0.009*
Austria		0.006	0.006
Denmark		0.008	0.010
Italy	0.006	0.006	0.008
Ireland	0.005	0.006	0.008*
Spain		0.002	0.002
Portugal	0.003*	0.002	0.004*

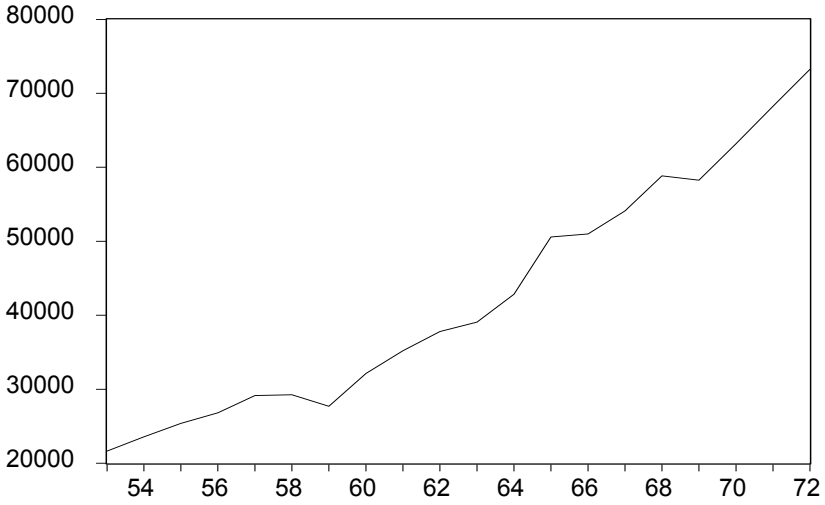
Note: *Reported value is one year later than reported
Source: Verspagen (1996)

Table VII
Foreign investment, Portugal (1965-1973)

	FDI	Portfolio	Total FI	FI/total inv
1965	726	77	803	2,27
1966	834	22	856	2,17
1967	785	129	914	2,19
1968	790	444	1234	2,68
1969	755	59	814	1,55
1970	770	30	800	1,31
1971	1482	50	1532	1,97
1972	2047	-613	1434	1,46
1973	2347	-34	2313	2,04

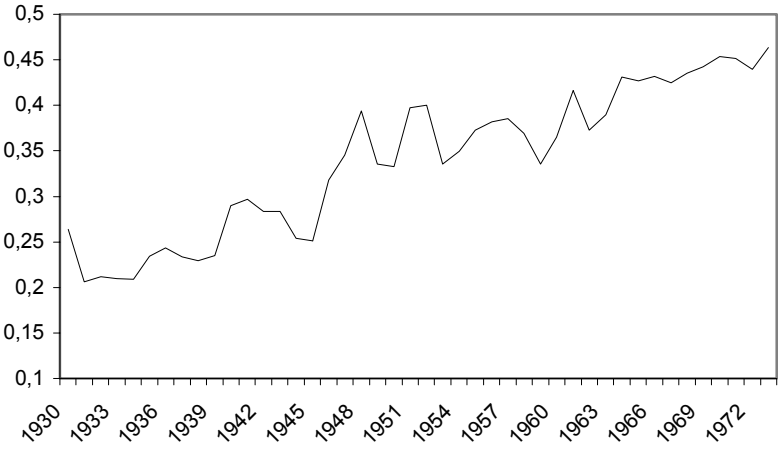
Source: Pinheiro (1997)

Figure 3
Volume of trade, Portugal, 1953-1973 (constant 1958 prices)



Source: Pinheiro (1997)

Figure 4
Exports+imports as a ratio of GDP, Portugal, 1930-1973



Source: Pinheiro (1997)

Table VIII
Augmented Dickey-Fuller tests for unit root for the TFP, investment, patents and trade series

Series name	α_0	β_1	β_2	β_{3a}	β_{3b}	β_{3c}	ADF critical values for β_2
TFP (levels)	0.628 (2.93)	0.019 (3.09)	-0.708 (-2.91)	0.161 (0.69)	0.510 (2.31)		1%: -4.62; 5%: -3.71; 10%: -3.30
TFP (1st differences)	0.0001 (0.008)	0.003 (1.77)	-1.18** (-4.49)				1%: -4.57; 5%: -3.69; 10%: -3.28
TFP (1st differences)	0.026 (2.60)		-1.059* (-3.91)				1%: -3.86; 5%: -3.04; 10%: -2.66
TFP (1st differences)			0.022* (3.40)				1%: -2.70; 5%: -1.96; 10%: -1.62
Patsnat (levels)	111.448 (3.90)	-0.641 (-0.65)	-1.068** (-4.28)				1%: -4.53; 5%: -3.67; 10%: -3.28
Patsnat (levels)	102.369 (4.18)		-1.042* (-4.31)				1%: -3.83; 5%: -3.03; 10%: -2.66
Patsnat (levels)			-0.027 (-0.40)	-0.490 (-2.27)			1%: -2.70; 5%: -1.96; 10%: -1.62
Patsnat (1st differences)	3.279 (0.20)	-0.331 (-0.24)	-1.502* (-6.78)				1%: -4.57; 5%: -3.69; 10%: -3.28
Patsnat (1st differences)	102.369 (4.18)		-1.042* (-4.31)				1%: -3.83; 5%: -3.03; 10%: -2.66
Patsnat (1st differences)			-1.500* (-7.20)				1%: -2.70; 5%: -1.96; 10%: -1.62
Patsfor (levels)	-433.781 (-1.56)	21.784 (-0.76)	0.946 (1.52)	-1.726 (-3.01)	-1.305 (-2.96)	-0.779 (-2.790)	1%: -4.67; 5%: -3.73; 10%: -3.31
Patsfor (1st differences)	-35.689 (-0.38)	20.053 (2.53)	-3.344** (-4-41)	1.362 (2.63)	0.536 (2.22)		1%: -4.67; 5%: -3.73; 10%: -3.31
Patsfor (1st differences)	32.836 (0.40)		-0.049 (-0.03)	-1.089 (-0.93)	-1.015 (-1.39)	-0.720 (-2.15)	1%: -3.96; 5%: -3.08; 10%: -2.68
Inv (levels)	-723.480 (-0.50)	58.86 (0.15)	0.106 (0.63)				1%: -4.53; 5%: -3.67; 10%: -3.28
Inv (1st differences)	-345.638 (-0.26)	310.942 (2.33)	-0.991** (-3.77)				1%: -4.57; 5%: -3.69; 10%: -3.28
Inv (1st differences)	-809.367 (-0.64)		0.130** (3.14)				1%: -3.83; 5%: -3.03; 10%: -2.66
Inv (1st differences)			-0.274 (-1.36)				1%: -2.70; 5%: -1.96; 10%: -1.62
Trade (levels)	4080.019 (1.51)	709.943 (1.62)	-0.208 (-1.25)				1%: -4.53; 5%: -3.67; 10%: -3.28
Trade (1st differences)	953.717 (0.80)	231.493 (2.14)	-1.241* (-4.96)				1%: -4.57; 5%: -3.69; 10%: -3.28
Trade (1st differences)	2856.839 (3.26)		-1.038* (-4.05)				1%: -3.86; 5%: -3.04; 10%: -2.66
Trade (1st differences)			-0.406 (-1.94)				1%: -2.70; 5%: -1.96; 10%: -1.62

Notes: TFP: TFP series; Patsnat: national patents series; Patsfor: foreign patents series; patstot: total patents series; Inv: investment series; trade: trade series
Values in parenthesis are t-stats
*Significant at the 1% level
**Significant at the 5% level
***Significant at the 10% level

Table IX
Cointegration tests

Dependent variable	Independent variables		
	Constant	**Patsnat**	**Trade**
TFP	0.834 (19.06)	-0.0005 (-1.41)	9.05E (18.61)
TFP	0.782 (34.60)		9.76E (11.26)
TFP	1.30 (8.00)	-0.001 (-0.81)	
	Constant	**Patsnat**	**TFP**
Trade	-85,442.79 (-10.30)	49.43 (1.26)	105,310.8 (18.61)
Trade	-79,008.53 (-11.89)		103,976.2 (18.41)
	Constant	**TFP**	**Trade**
Patsnat	266.68 (2.32)	-206.64 (-1.41)	0.002 (1.26)
Patsnat	130.18 (3.31)	-27.001 (-0.81)	

Values in parenthesis are t-stats

Table X
Augmented Dickey-Fuller tests for unit root in the residual of cointegration test

Residual cointegration test	α_0	β_1	β_2	β_{3a}	β_{3b}	β_{3c}	β_{3d}	ADF critical values for β_2
TFP dependent variable	0.0068 (0.54)	8.15E (0.08)	-1.150** (-4.44)	0.378 (1.84)	0.568 (3.10)	0.691 (2.85)	0.512 (2.07)	1%: -4.73 5%: -3.76 10%: -3.32
TFP dependent variable	0.0078 (2.02)		-1.14* (-5.00)	0.372 (2.06)	0.565 (3.32)	0.686 (3.07)	0.506 (2.27)	1%: -3.96 5%: -3.08 10%: -2.68
TFP dependent variable			-0.520* (-3.23)	0.295 (1.46)	0.586 (2.73)			1%: -2.72 5%: -1.96 10%: -1.62
Trade dependent variable	-2,625.55 (-2.05)	154.39 (1.53)	-1.11** (-4.47)	0.396 (1.92)	0.53 (2.85)	0.65 (2.77)	0.52 (2.15)	1%: -4.73 5%: -3.76 10%: 3.32
Trade dependent variable	-787.77 (-1.65)		-1.13* (-4.23)	0.47 (2.19)	0.55 (2.79)	0.64 (2.56)	0.56 (2.14)	1%: 3.96 5%: -3.08 10%: 2.68
Trade dependent variable			-0.51* (-3.12)	0.30 (1.48)	0.55 (2.53)			1%: 2.72 5%: -1.96 10%: -1.63

*Significant at the 1% level
**Significant at the 5% level
***Significant at the 10% level
Values in parenthesis are t-stats

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