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The Tobin Tax: A Review of the Evidence

Neil McCulloch and Grazia Pacillo

May 2011

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The Tobin Tax: A Review of the Evidence

Neil McCulloch[1] and Grazia Pacillo

May 2011

Institute of Development Studies at the University of Sussex Brighton BN1 9RE UK

1 Corresponding author: N.McCulloch@ids.ac.uk

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Summary

The debate about the Tobin tax, and other financial transaction taxes (FTTs), gives rise to strong views both for and against. Unfortunately, little of the popular debate refers to the now considerable body of evidence about the impact of such taxes. This review attempts to synthesise what we know from the available theoretical and empirical literature about the impact of FTTs on volatility in financial markets. We also review the literature on how a Tobin tax might be implemented, the amount of revenue that it might realistically produce, and the likely incidence of the tax. We conclude that, contrary to what is often assumed, a Tobin tax is feasible and, if appropriately designed, could make a significant contribution to revenue without causing major distortions. However, it would be unlikely to reduce market volatility and could even increase it.

Keywords: financial transaction; Tobin tax; volatility; revenue; incidence; payment systems; implementation

Neil McCulloch is an economist at the Institute of Development Studies specialising in the analysis of poverty in developing countries and the linkages between poverty, and global and local economic reform. He has led research on the rural investment climate in Indonesia and has worked on the relationship between growth and poverty reduction in this country. He has published numerous academic papers of the movement into and out of poverty and the effectiveness of different anti-poverty policies.

Grazia Pacillo is currently a DPhil student at the University of Sussex with research interests in development economics, agricultural economics and international trade. Her current research studies the role of agriculture in economic growth and poverty reduction in Ghana, focusing on crop diversification, small farmers' participation in global chains and the role of biofuels. She has worked on various projects on finance, development and agricultural economics for the Institute of Development Studies, the UK Department for International Development and the Overseas Development Institute. Prior to her current research studies, she was awarded a Laurea Specialistica (Honours) and a Laurea Triennale at the University of Bologna. She also achieved the status of Junior Expert in Management of EU Projects and International Cooperation, from Regione Puglia (regional government), Mediterranean Sector.

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Acronyms

ABS	Automated Bond System
ADR	American Depositary Receipts
AMEX	American Stock Exchange
ARMA	Auto Regressive Moving Average
ASE	Athens Stock Exchange
BIS	Bank for International Settlements
CBOE	Chicago Board Options Exchange
CDS	credit default swaps
CfD	contracts for difference
CHAPS	Clearing House Automated Payment System
CIT	corporation income tax
CLS	Continuous Linked Settlement
CME	Chicago Mercantile Exchange
DvP	delivery-versus-payment
EBTD	European Bank for Reconstruction and Development
Forex	foreign exchange
FTT	financial transaction tax
GARCH	Generalised Auto Regressive Conditional Heteroskedasticity
GCMG	grand canonical minority game
HAM	heterogeneous agent model
LIBA	London Investment Bankers Association
NYSE	New York Stock Exchange
OTC	over the counter
PFTT	politically feasible Tobin tax
PvP	payment-versus-payment
RTGS	real-time gross settlements
SEAQ	Stock Exchange Automated Quotation
SHSE	Shanghai Stock Exchange
STET	securities transaction excise tax

STT	securities transaction tax
SURE	seemingly unrelated regressions estimation
SZSE	Shenzhen Stock Exchange
TARGET	Trans-European Automated Real-time Gross Settlement Express Transfer
TSE	Tokyo Stock Exchange
ZI	zero intelligence

Executive summary

In 1978, the Nobel Laureate in Economics James Tobin proposed to ‘throw some sand in the wheels of our excessively efficient international money markets’, by levying a small tax on all foreign exchange transactions in order to penalise short-term speculators but not long-term investors. The idea was that discouraging speculative behaviour would stabilise markets. Ever since, the issue of the ‘Tobin’ tax (and other similar financial transaction taxes) has generated emotive debate. On the one hand, many economists share an instinctive dislike for taxing transactions and most working in the financial sector regard it as unworkable or naive. But on the other hand, campaigning groups such as the Robin Hood Tax campaign, many politicians and some economists propose financial transaction taxes in reaction to major financial crises.

This paper presents the results from our systematic review of the evidence both for and against financial transaction taxes (FTTs). Specifically we review the evidence on four key questions:

1. What is the impact of FTTs on volatility?
   We review the results from the main theoretical models that have been developed, as well as the findings from computational simulations, and compare (and contrast) these with the findings from the empirical literature, looking at the impact of similar kinds of transaction costs and taxes.

2. Is an FTT feasible?
   A key concern running through the debate is whether it is actually feasible to implement such taxes in a way that would prevent significant avoidance. Three key questions arise here. First, what instruments should be taxed (and would market actors simply be able to substitute non-taxed instruments for taxed ones to avoid the tax)? Second, at what point in the payment system (i.e. trading, clearing or settlement) and on what resource (e.g. registration, brokerage) should the tax be imposed? Third, what should the scope of the tax be? Should it cover domestic assets or also foreign assets; domestic market actors or also foreign actors; transactions taking place in the domestic market or also those taking place abroad? Related to this, is the issue of whether market actors can circumvent the tax by migrating their business, or at least their trades, to untaxed centres, and whether it would therefore be necessary to get agreement among all, or a large number of key countries for the tax to be effective.

3. How much money would an FTT collect?
   The answer to this question is clearly determined by the answers to the feasibility questions above. We outline the large range of estimates in the literature of the revenue that would be collected and attempt to explain how the figures produced depend on the coverage of instruments, actors and countries and the rates applied. We also examine the existing estimates of the elasticity of trade volume with respect to the tax and the effect that this has on the revenue figures obtained. Finally, we conduct a meta-analysis of the revenue collection potential using the median estimates from the literature.

4. What would be the incidence of the Tobin tax?
   Unfortunately, the analytical and empirical literature on the incidence of a Tobin tax is rather sparse. Nonetheless, we examine the merits of the various positions taken and draw on the literature on the incidence of other taxes in an attempt to come to a reasoned judgement about the likely incidence of the tax.

Our review focuses on FTTs which affect the wholesale market. We do not consider non-financial transaction taxes (e.g. taxes on the exchange or trade in goods or services); nor do we explore non-transaction taxes on financial assets (e.g. capital gains tax, or the recently proposed financial assets tax). Nor do we consider transaction taxes oriented to the retail market e.g. bank debit taxes. Even with these restrictions, our definition is broad, covering taxes on the exchange of the entire range of financial securities, including bonds, shares and foreign exchange as well as the spot, forward, swaps, futures and options markets for these assets. When referring to this full range of transaction taxes we use the term financial transaction taxes (FTT). When referring only to transaction taxes on foreign exchange we will use the term Tobin tax, since Tobin's original idea related only to the taxation of foreign exchange transactions.

Key findings

1 What is the impact of FTTs on volatility?

Summary: Although some theoretical models suggest that FTTs reduce volatility, most empirical evidence shows that higher transaction costs are actually associated with more, rather than less, volatility.

Would an FTT dampen volatility in financial markets or would it squeeze out liquidity, potentially making volatility worse? There are two approaches to this question. First, there is an extensive theoretical literature examining whether such taxes would stabilise markets, along with simulations showing how market participants might react to the imposition of such a tax. Second, there is empirical work examining the actual impact on markets when similar taxes have been imposed in various countries.

Theoretical models

Over the last 20 years, a new generation of theoretical models has looked at the 'microstructure' of financial markets to try to explain the behaviour of real financial markets. These models typically assume that market actors apply rules of thumb when making decisions to buy or sell.

A distinction is usually drawn between 'fundamentalist' traders (those who trade based on a view about the fundamental value of the assets) and 'noise' traders (speculators). The volatility of the market is therefore driven by what share of market traders are noise traders (who increase volatility) and what share are fundamentalists (who reduce it). In such models, an FTT will have an effect on volatility if the imposition of the tax changes the share of noise traders in the market.

Generally speaking, theoretical models find that an FTT should reduce volatility by reducing the number of noise traders. But many models also suggest that care should be taken in choosing the size of the tax. If it is too large, the reductions in market trading and liquidity could result in an increase rather than a decrease in volatility.

Empirical evidence

Real financial markets do not necessarily behave the way that theoretical models predict. Most of the studies examining the link between transaction costs and volatility find a *positive* relationship between the two – that is, higher transaction costs are associated with more, rather than less, volatility. For example, Bessembinder and Rath (2002) analyse stocks moving from the NASDAQ stock market to the New York Stock Exchange (NYSE).They find strong evidence that the newly NYSE-listed stocks reduce both trading costs and the volatility of daily returns. Similarly, Hau (2006) studies French stocks, finding that a 20 per cent increase in transaction costs generates an increase in volatility of about 30 per cent.

Studies of foreign exchange markets also suggest that higher transaction costs are associated with greater volatility. For example, Aliber, Chowdhry and Yan (2003) look at transaction costs, volatility and trading volume in foreign exchange markets. They find that an increase of 0.02 per cent in transaction costs leads to an increase of volatility of 0.5 percentage points.

Turning to the few studies of actual transaction taxes, we find a similar story. Sweden introduced a 1 per cent round trip tax on equity transactions in 1984, which was increased to 2 per cent in 1986. Umlauf (1993) compares the performance of the Swedish stock market under the no tax, 1 per cent and 2 per cent tax regimes. He concludes that the imposition and increase of the transaction tax increased volatility. He also notes that there was huge market diversion from the Swedish towards the London stock market as a result of the tax. On the other hand, Saporta and Kan (1997) find no significant effect of UK stamp duty imposition on the volatility of equity prices in the UK.

2 Is an FTT feasible?

Summary: We find that due to changes in the way transactions are settled it is now much easier for countries to unilaterally introduce certain forms of FTT, such as a currency transaction tax.

Many of the arguments against the introduction of FTTs are related to the ability to implement such taxes effectively. There are three core implementation concerns: substitution of untaxed instruments; matching tax rates to transaction costs; and migration to different markets.

Substitution refers to the ability of market actors to shift away from taxed financial instruments to untaxed instruments. To address the problem of substitution, most supporters of FTTs have argued that the tax should cover a broad range of financial instruments including spot (immediate transaction), forward (transaction in a few days), and swap (combined spot and forward) transactions. There is less agreement in the literature about whether futures and options should, or even could, be taxed. Similarly there is a debate about whether it would be feasible to include transactions in the over-the-counter (OTC) market (i.e. not on exchanges), with concerns that an FTT might reduce transparency by pushing transactions off exchanges. Notwithstanding this, the general conclusion of the literature is that the tax would have to be applied to a broad range of instruments in order to be effective.

To avoid major distortions it is generally agreed that the tax rate would have to be a small percentage of the size of existing transaction costs in financial markets. However, the size of transaction costs varies enormously across markets suggesting that there would have to be a range of different tax rates in different markets. For example, transaction costs in foreign exchange markets are a small fraction of those in equity markets; a tax rate (as a share of the value of the trade) would therefore have to be very much smaller on foreign exchange transactions than on equity transactions in order to ensure that the tax as a share of existing transaction costs is roughly comparable across markets.

Migration refers to the ability of market actors to shift their activities to untaxed locations. If a tax were introduced in one country, but the same trade could be undertaken in another country, one would probably see substantial migration of trade away from countries imposing the tax. There are two solutions to this problem: first, if the tax were implemented by all the major financial centres, then the incentives for migration would be much smaller; second, unilateral (or plurilateral) implementation would be feasible if one could tax a resource over which the taxing jurisdiction has a legal or practical monopoly. Thus stamp duty on equities is feasible because individual countries control the registration and transfer of ownership of shares issued by companies registered in that country.

Countries also have some control over the settlement of foreign exchange trades in their own currency. Moreover, unilateral introduction of a tax on foreign exchange transactions has been made easier in recent years due to a strong shift towards centralisation, formalisation and regulation of settlement sites. The Continuous Linked Settlement Bank, launched in 2002, now settles more than half of all foreign exchange transactions, with the remainder processed through national real-time gross settlements systems. Both of these systems allow a one-to-one correspondence between foreign exchange payments and their originating trades. Moreover, the messaging and netting system, SWIFT, is more or less universally adopted so that central banks can enforce the tax on offshore netting systems and on derivatives. As a result, it is now much easier for countries to unilaterally implement an FTT on foreign exchange trades at the settlement sites, because they are formal, organised and centralised.

3 How much money would an FTT collect?

Summary: We find that applying a 0.005 per cent tax to the foreign exchange market alone might raise around US$25 billion per year (£17 billion) worldwide. The revenue potential for the UK would be around US$11 billion (£7.5 billion). Applying an FTT to other markets, e.g. derivatives and OTC markets, is more difficult, but, if successful, could raise much larger sums.

We have reviewed the very large number of estimates in the literature of the amount of money that an FTT would collect. These estimates depend on three key factors: which markets are taxed (equity, foreign exchange, derivatives, OTC); the rate of taxation; and the reduction in trade caused both by the tax and by avoidance. Using data on the size of each of the financial markets (including equity, derivative, foreign exchange and OTC markets) and assuming 250 trading days, we calculate the median of the empirical estimates of the size of the transaction costs in each market. In keeping with the consensus in the literature that the tax should be small, we adjust the tax rate so that it represents a 20 per cent increase in the transaction costs of trading in that market. Having no evidence on the extent of fiscal evasion, we use 20 per cent, which is the median figure used in other simulations. Similarly, we use the median elasticity of volume with respect to transaction costs in each market found from empirical studies.

Based on these assumptions, Table ES1 shows the estimates of the revenue that would be collected for each of the markets, based upon a tax rate equal to 20 per cent of the existing transaction costs in each market.

We find that applying a 0.005 per cent tax to the foreign exchange market alone might raise around US$25 billion per year worldwide. Including the other markets, the revenue raised could reach over US$250 billion, even if the OTC market is excluded, and well over US$800 billion if it is included. These are large sums, especially compared to the US$121 billion estimated aid from wealthy countries to poor countries in 2008. The revenue potential for the UK is also significant – around US$11 billion (£7.5 billion) from a 0.005 per cent tax applied only to the foreign exchange market. This is roughly the same as the entire UK international aid budget.

Like all revenue estimates in this area, these results should be treated with considerable caution. Although implementing the tax on foreign exchange transactions is clearly feasible, the application of the tax to derivative and OTC markets would be much more difficult. At the same time, the existing evidence does support the view that a relatively small FTT could yield relatively large sums of revenue.

Table ES1 Meta-estimate of revenue from a financial transaction tax

Market	World ($ bn)	UK ($ bn)	Tax rate (20% of transaction cost)	Elasticity of volume with respect to transaction costs	Total annual revenues world ($ bn)	Total annual revenues UK ($bn)
Equity	456	18	*0.233*	0.58	191	7.6
Derivative	4,933	1,335	*0.008*	1.5	58	15.7
Foreign exchange	2,914	1,269	*0.005*	0.606	25	10.9
OTC	2,544	1,094	*0.152*	1.5	589	253.3
				Without OTC	**274**	**34.2**
				With OTC	**863**	**287.6**

Note: It is assumed that the volume of trade is reduced by 20 per cent due to avoidance, and by a further amount due to the tax itself according to the elasticity shown.

4 Who would end up paying the tax?

Summary: There is general agreement that wholesale traders would bear the initial cost of the tax. In the long run, a significant proportion of the tax could end up being passed on to consumers (i.e. owners of capital).

One of the most prominent claims made by proponents of FTTs is that the tax would be extremely progressive, primarily affecting wealthy institutions and individuals. By the same token, opponents of the tax have argued that the tax would end up being paid by end users in the form of wider spreads or higher borrowing costs.

Unfortunately, the evidence about who would ultimately pay the Tobin tax is very sparse. Although there is general agreement that wholesale traders, particularly those involved in short-term foreign exchange transactions, would bear the initial cost of the tax, the final incidence will depend on the extent of competition in different segments of the financial sector. The literature on the incidence of corporate income tax suggests that, in the long run, a significant proportion of the tax could end up being passed on to consumers. However, given that most households earn relatively little of their income from returns to capital, it would seem likely that an FTT would be more progressive than several other forms of taxation, such as value added tax.

This conclusion would only be affected if the outflow of capital in countries imposing the tax caused a long-run decline in unskilled wages. The literature provides some evidence that this can happen. However, this effect would be reduced substantially if the tax were to be imposed by all the major financial centres, since this would reduce the incentives for capital outflows. There is a clear need for further empirical research to ascertain the incidence of FTTs that have already been applied.

Conclusions

In an environment in which the governments of most of the world's financial centres are faced with making large spending cuts, the existence of a significant source of currently untapped revenue is important. Although the evidence is not conclusive on all points, it seems clear that an FTT is implementable and could make a significant contribution to revenue in the major financial economies. It seems unlikely that it would stabilise financial markets but, if appropriately designed, it is unlikely to destabilise them either. Although a multilateral agreement between the key economies is clearly preferable, it would not be impossible to implement unilaterally, at least for a major economy. The incidence of such a tax would not be as progressive as some of its proponents claim, but we have no reason to believe that it would be significantly worse than most alternatives, nor that it would be any more difficult to collect.

1 Introduction

In 1972, in the Janeway Lectures at Princeton, James Tobin suggested that it might be a good idea to impose a currency transactions tax in order to enhance the efficacy of macroeconomic policy (Tobin 1974). He reiterated this view in his presidential address to the Eastern Economic Association in 1978 (Tobin 1978). The proposal did not get a good reception. As Tobin wrote, ‘it did not make much of a ripple’ (Tobin 1996). However, over the subsequent 30 years, every time there has been some form of financial or currency crisis, there is renewed discussion about whether the implementation of a Tobin tax might be an appropriate policy response.

The Tobin tax is an emotive issue. On the one hand such a tax is, as Tobin himself put it, ‘anathema to Central Bankers’. Many economists share an instinctive dislike for taxing transactions, often because they believe that such taxes reduce the efficiency of competitive markets and impose welfare costs. Bankers and other participants in financial markets are also often opposed because they regard it as unworkable or naive. On the other hand, campaigning groups, politicians and economists frequently raise the issue of the Tobin tax (and other similar financial transaction taxes) in reaction to major financial crises because of its purported ability to stabilise markets. High volatility in the markets can be economically damaging, due to its negative impact on investment, and so if a Tobin tax actually did stabilise markets this could be a significant benefit. Moreover, the fiscal difficulties created by the current crisis have led to renewed calls for the imposition of such a tax, both to boost tax revenues and as a means of extracting a larger contribution from the financial sector to fund a wide range of national and international public goods.[2]

Despite the long-standing debate on the issue, the arguments aired in the popular debate, by both proponents and opponents of the tax, are sometimes rather poorly grounded in evidence. This is surprising, because there is now a voluminous literature on the Tobin tax. This includes extensive theoretical work examining whether Tobin and Tobin-like taxes would stabilise markets in principle, simulations which explore how simple agents acting according to specified set of rules would react to the imposition of such a tax, and empirical work examining the actual impact upon markets and revenue when similar taxes have been imposed in various countries. In addition, there is a comprehensive literature on potential ways in which such a tax might be implemented and the pitfalls, difficulties and possibilities associated with these differing modalities. In short, there is a great deal that we already know about the pros and cons of Tobin and Tobin-like taxes.

The aim of this paper is to lay out, in a disinterested fashion, the evidence currently available. Specifically we will attempt to review the evidence on four key questions:

1. What is the impact of financial transaction taxes on volatility?
   We will review the results arising from the main theoretical models that have been developed, as well as the findings from computational simulations. We then describe the findings from the empirical literature associated with similar kinds of transaction costs and taxes.

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2 The current Robin Hood Tax campaign (www.robinhoodtax.org) is the most recent embodiment of such a campaign focused on the revenue benefits of such a tax. See Brauer (2002) and Patomäki (2007) on the history and causes of such campaigns.

2. Is a financial transaction tax feasible?
   A key concern running through the debate is whether it is actually feasible to implement such taxes in a way that would prevent significant avoidance. Three key questions arise here. First, what instruments should be taxed (and would market actors simply be able to substitute non-taxed instruments for taxed ones to avoid the tax). Second, at what point in the payment system (i.e. trading, clearing or settlement) and on what resource (e.g. registration, brokerage) should the tax be imposed? Third, what should the scope of the tax be? Should it cover domestic assets or also foreign assets; domestic market actors or also foreign actors; transactions taking place in the domestic market or also those taking place abroad? Related to this is the issue of whether market actors can circumvent the tax by migrating their business, or at least their trades, to untaxed centres, and whether it would therefore be necessary to get agreement among all, or a large number of key countries for the tax to be effective.

3. How much money would a financial transaction tax collect?
   The answer to this question is clearly determined by the answers to the feasibility questions above. We outline the large range of estimates in the literature of the revenue that would be collected and attempt to explain how the figures produced depend on the coverage of instruments, actors and countries and the rates applied. We also examine the existing estimates of the elasticity of trade volume with respect to the tax and the effect that this has on the revenue figures obtained. Finally, we conduct a meta-analysis of the revenue collection potential using the median estimates from the literature.[3]

4. What would be the incidence of the Tobin tax?
   Unfortunately, the analytical and empirical literature on the incidence of a Tobin tax is rather sparse. Nonetheless, we examine the merits of the various positions taken and draw on the literature on the incidence of other taxes in an attempt to come to a reasoned judgement about the likely incidence of the tax.

Given the range of terms used to describe financial transaction taxes, it is useful to define the scope of our review. We are interested in financial transaction taxes which affect the wholesale market. We do not consider non-financial transaction taxes (e.g. taxes on the exchange or trade in goods or services); nor do we explore non-transaction taxes on financial assets (e.g. capital gains tax or the recently proposed financial assets tax (IMF (2010)). Moreover, we do not consider transaction taxes that are oriented to the retail market, e.g. bank debit taxes. Even with these restrictions, our definition is broad, covering taxes on the exchange of the entire range of financial securities, including bonds, shares and foreign exchange as well as the spot, forward, swaps, futures and options markets for these assets. When referring to this full range of transaction taxes we use the term financial transaction taxes (FTTs). When referring only to transaction taxes on foreign exchange we will use the term Tobin tax, since Tobin's original idea only related to the taxation of foreign exchange transactions. However, we broaden Tobin's original concept to include all forms of transaction tax on the foreign exchange market, including forward, futures and options, not merely those pertaining to the spot market.

3 We do not tackle the issue of whether the revenue from such a tax should be hypothecated for development or other global public goods, and, if so, what mechanisms should be put in place for revenue sharing. On this issue see Johnson (1997) and Kaul and Langmore (1996).

2 The impact of financial transaction taxes on volatility

Tobin's original proposal was focused on reducing the volatility of markets.[4] His reasoning, and that used subsequently in much of the debate, was that very short-term transactions are more likely to be destabilising than long-term transactions based on market fundamentals. A tax on each transaction represents a much higher tax rate for short-term than for long-term investments, hence discouraging the former. As he puts it:

> Most disappointing and surprising, critics seemed to miss what I regarded as the essential property of the transaction tax – the beauty part – that this simple, one-parameter tax would automatically penalize short-horizon round trips, while negligibly affecting the incentives for commodity trade and long-term capital investments. A 0.2 per cent tax on a round trip to another currency costs 48 per cent a year if transacted every business day, 10 per cent if every week, 2.4 per cent if every month. But it is a trivial charge on commodity trade or long-term foreign investments.
> (Tobin 1996: xi)

If it is true that short-term transactions induce more volatility than long-term trades, the tax should reduce overall market volatility.

The assumptions underlying this reasoning have been subject to comprehensive scrutiny in both the theoretical and the empirical literature. We start by briefly reviewing the traditional theoretical work on the topic in the tradition of Keynes and Friedman. The opposing views about the impact of speculation on volatility arising from the traditional literature gave rise to a closer focus in theoretical models on the microstructure of these markets and the characteristics of traders (Frankel and Rose 1994). These models depart from traditional assumptions of fully rational agents. Rather, market actors are assumed to have bounded rationality, making decisions according to 'rules of thumb' which may not necessarily be optimal. In addition, these heterogeneous agent models take into account the fact that market actors may have different interests, capabilities and access to funding. A further group of models adopt the heterogeneous agent approach but allow interaction between the various agents in ways that can affect aggregate variables (Westerhoff 2003; Westerhoff and Dieci 2006).

A second group of theoretical studies focus on zero intelligence atomistic models based on percolation theory (Cont and Bouchaud 2000). These models reproduce excess volatility and fat tails in the distribution of returns, through herding behaviour in the population of traders (e.g. Ehrenstein, Westerhoff and Stauffer 2005; Mannaro, Marchesi and Setzu 2008). This class of models, though neglecting any notion of optimising behaviour, has the virtue of taking into account the discrete nature of traders, whereas in the heterogeneous agent approach only

4 The second stated aim of his paper was to preserve and promote autonomy of national macroeconomic policies, but we do not consider this here (see Arestis and Sawyer 1997 for an assessment).

the effect of the aggregate demand of different types of traders matters (Bianconi, Galla, Marsili and Pin 2009).

We then review game theoretical approaches to modelling the impact of Tobin-like taxes on volatility (Bianconi *et al.* 2009; Kaiser, Chmura and Pitz 2007). All three of these approaches are better than traditional models in reproducing the 'stylized facts' of real financial markets (Cont 2001) such as excess volatility, the fat-tailed distribution of returns and volatility clustering.

Finally, we provide a brief review of papers which, whilst adopting one of the theoretical frameworks above, have undertaken simulations or laboratory experiments to test whether the theory holds in such a setting.

After reviewing the theoretical literature, we turn to the empirical literature. Since a Tobin tax, as originally envisaged, has never been implemented, the empirical evidence of the impact of a transaction tax in the foreign exchange market is much more sparse than the theoretical literature. However, numerous countries have implemented a variety of FTTs (see IMF 2010 for a recent review). We therefore draw on the empirical literature assessing the impact of these taxes on volatility. We conclude with an overall assessment of the evidence about the impact of FTTs on volatility from both the theoretical and empirical literature.

2.1 Theoretical models

2.1.1 Traditional theoretical debates

Tobin's proposal for a financial transaction tax was by no means the first. Keynes famously argued that, 'Speculators may do no harm as bubbles on a steady stream of enterprise. But the situation is serious when enterprise becomes the bubble on a whirlpool of speculation' (Keynes 1936: 159).

His solution was to propose a transaction tax on equity trades, on the assumption that short-term trades are likely to be more destabilising to financial markets than longer-term trades. Indeed this is the underlying rationale behind the arguments of a very large number of papers supporting FTTs.[5]

However, this view was famously challenged by Friedman (1953), who argued that speculation could not be destabilising in general since, if it were, the actors involved would lose money:

> People who argue that speculation is generally destabilizing seldom realize that this is largely equivalent to saying that speculators lose money, since speculation can be destabilizing in general only if speculators on the average sell when the currency is low in price and buy when it is high.
> (Friedman 1953: 175)

This strand of the literature therefore argues that speculative opportunities occur when the market is inefficient, and that rational arbitrage trading on unexploited

5 Note that this is not the only possible causal pathway. Erturk (2006) argues that a Tobin tax can potentially have a stabilising effect on international currency markets, not because it reduces the excessive volume of transactions of speculators, but because it can slow down the speed with which market traders react to changes in prices of currencies.

profit opportunities is effective in clearing markets and stabilising prices, bringing them down to their fundamental values (Fama 1965). As is well known, the theoretical basis for the view that taxes reduce efficiency and impose welfare costs depends on a particular set of assumptions about the market which may not hold. For example, Stiglitz (1989) showed that markets are not necessarily efficient when there are externalities or asymmetric information. More generally, Greenwald and Stiglitz (1986) showed that whenever markets are incomplete and/or information is imperfect, tax interventions may be Pareto improving.

2.1.2 Beyond traditional theoretical approaches

Traditional models of financial markets tend to assume optimising agents with rational expectations about future events (i.e. that forecasts are perfectly consistent with the realisation of the events so that agents do not make consistent mistakes.) However, such models do not explain many of the characteristics that are observed in real financial markets such as excess liquidity (i.e. excessive trading activity due to speculative trade), excess price volatility, fat-tailed distributions of returns (i.e. a much higher probability of very large positive and negative changes) and volatility clustering (i.e. switches between periods of high and low volatility).

To try to account for these, a new generation of theoretical models looked at the ‘microstructure’ of financial markets. These models typically assume that market actors are not perfectly rational, but rather apply rules of thumb when making decisions to buy or sell, based on whatever information they have at their disposal. They also assume that there are different types of market actors. As a result these models are known as heterogeneous agent models.

2.1.3 Heterogeneous agent models[6]

Models which assume rational traders with complete information face a fundamental difficulty because theory would suggest that, in these circumstances, there should be no trade. This is because a trader with superior private information about an asset should not be able to benefit from his information, because other rational traders, seeing the first trader trying to buy, would anticipate that he must have positive information about the asset and would therefore not be willing to sell the asset to him (Milgrom and Stokey 1982). Heterogeneous agent models (HAMs) attempt to find a solution to this problem by assuming that traders are different from one another, and that they are boundedly rational.[7] Agents do not have complete information about the market because

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6 See Hommes (2006) for a comprehensive review of this class of models. Westerhoff (2008) reviews their use in understanding regulatory policies, including transaction taxes.

7 Formalised by Herbert Simon in 1957, the concept of bounded rationality argues that agents are not fully rational, i.e. they do not know everything about the other agents in the market or about market characteristics. Rather, they form expectations based upon observable quantities and adapt their forecasting rule as additional observations become available. Adaptive learning may converge to a rational expectations equilibrium or it may converge to an ‘approximate rational expectations equilibrium’, where there is at least some degree of consistency between expectations and realisations. There is also an extensive literature in psychology describing how behaviour under uncertainty can be driven by heuristics and biases (Kahneman and Tversky 1973).

gathering the necessary information is very costly, and because there is fundamental uncertainty about what the 'correct fundamentals' are (Keynes 1936). As a result they use a range of rules of thumb to set their strategies.

HAMs in financial markets typically assume the existence of at least two different types of traders: 'fundamentalists', who base their expectations about future asset prices and their trading strategies on market fundamentals and economic factors, such as market dividends, earnings, macroeconomic growth, exchange rates, etc; and 'chartists' or 'noise traders' who base expectations and trading strategies on historical patterns. The latter employ a variety of 'technical trading rules' based on moving averages – buying when the short-run moving average crosses the long-run moving average from below and selling when the opposite occurs (Schulmeister 2009). In such a set-up, the volatility of the market is driven by the share of market traders that are noise traders (who increase volatility) relative to the share that are fundamentalists (who reduce it).[8]

De Long, Shleifer, Summers and Waldmann (1990a, 1990b) formalised such a model in which fundamentalists are called 'sophisticated traders' and the chartists are 'noise traders'. The noise traders use signals from technical analysis, economic consultants and stockbrokers to set their portfolio, irrationally (in the model) believing that these sources contain correct information. Sophisticated traders exploit this misperception, buying when noise traders depress prices and selling when prices are inflated. Thus sophisticated traders pursue a contrarian strategy, pushing prices towards their fundamental values. One advantage of these models is that they give more realistic outcomes in terms of the stylised facts of these markets, such as excess volatility (De Grauwe and Grimaldi 2006).

Frankel and Froot (1990a, 1990b) apply such a model to the exchange rate markets and extend it by adding another agent: the portfolio managers. As before, chartists use moving averages to trade, taking only the past exchange rate into account, but it is the portfolio managers who actually buy and sell foreign assets. They form their expectations as a weighted average of the forecasts of fundamentalists and chartists, adapting the weight over time in the direction that would have yielded a perfect forecast (Hommes 2006). Simulation of this model shows that exchange rates may exhibit temporary bubbles during which the weight that portfolio managers place on the forecasts of fundamentalists is negative, inducing (in this model) an increase in the exchange rate. However, when the exchange rate goes too far away from its fundamental value, portfolio managers increase the weight given to fundamentalists, thereby accelerating a depreciation. Frankel and Froot (1990a, 1990b) therefore show that, when the behaviour of portfolio managers is driven by bounded rationality, it is possible for exchange rate markets to exhibit significant temporary deviations from market fundamentals.

Haberer (2004) describes the effect of a transaction tax in a perfectly efficient market and in an inefficient market – where efficiency is defined as the ability of the market to incorporate news. The efficient market is composed of fully rational agents with complete information about the structure of the model and the behaviour of relevant fundamentals. In this market, all market participants are

8 See Dow and Gorton (2006) for a review of the literature on noise traders.

homogeneous and new information causes the price to change towards a new equilibrium through an approximation path.[9] Greater liquidity in this market helps prices to reach the new equilibrium and reduces volatility. The inefficient market, by contrast, is composed of heterogeneous participants (fundamentalists, who do not contribute to excess volatility, and chartists, who do) with different expectations and forecasting techniques. In this market, higher liquidity due to speculation increases volatility. Taking the two markets together, Haberer therefore suggests that there may be a U-shaped relationship between liquidity and excess volatility. At low levels of market volume, greater liquidity reduces excess volatility. However, after a certain point, the confusion caused by speculation creates a positive relationship between liquidity and excess volatility. This suggests that a transaction tax in a low liquidity market would increase volatility, but in highly liquid markets such a tax may reduce volatility by reducing the incentives for speculative trading.[10]

Shi and Xu (2009), augmenting Jeanne and Rose's (2002) study on the effect of a transaction tax on 'noise trading', analysed the effect of a Tobin tax on exchange rate volatility. Again, the idea is that exchange rate volatility is caused by changes in the relative share of fundamentalist and noise traders. A transaction tax might reduce exchange rate volatility by reducing the number of noise traders. They analysed entry costs for both informed traders (fundamentalists) and noise traders (chartists) after the introduction of a transaction tax in a general equilibrium model. A key assumption is that informed traders' unconditional expectation of excess return depends on the 'noise component', i.e. the ratio of noise entrants to informed entrants, but that this does not influence noise traders' expectations. An increase in the noise component increases market volatility. It also changes the risk premium and the gross benefit of entry, but in a different way for informed and noise traders because of the asymmetry in their expectations.

Shi and Xu find that, when the entry decisions of all traders are endogenous, three equilibria are possible. In the first equilibrium, the noise component is one, i.e. there are the same number of noise and informed entrants, so all traders form their expectations in the same way. As a result, an increase in entry costs due to a transaction tax leads them to leave the market in pairs. The 'asymmetric expectation effect' therefore disappears and the gross benefits of entry are only affected by market depth (i.e. the sum of informed and noise traders). Hence a transaction tax only reduces market depth and does not affect volatility, since it does not influence the composition of traders. The second equilibrium occurs when the noise component is different from one. If entry costs are increased due to the tax, the asymmetry in expectations causes a larger reduction in the gross benefits of entry for informed traders than for noise traders. This, in turn, affects the composition of traders, increasing the noise component and, thereby, volatility. The third equilibrium occurs when the entry cost is sufficiently high to prevent the

9 There is not an instantaneous jump to the new equilibrium because agents are not perfectly aware of others' expectations in this model.

10 See Demary (2010) for a model in which a small transaction tax reduces volatility, but a larger tax increases it; Dupont and Lee (2007) also model how a tax could both increase and decrease volume depending on market conditions. Habermeier and Kirilenko (2003) argue that security transaction taxes reduce the informational efficiency of markets.

entry of noise traders. In this case, the introduction or increase of a transaction tax has no effect on volatility. Thus a Tobin tax will have an effect on volatility only if there are entry costs and if its imposition changes the share of noise traders in the market. Moreover, in Shi and Xu's model, the imposition of a Tobin tax does not reduce volatility but may increase it depending on the ratio of noise to informed entrants.[11]

Bloomfield, O'Hara and Saar (2009) raise the same issue in an experimental context. They show that a uniform tax on noise traders and sophisticated traders has little effect on volatility. A paper by Foucault, Sraer and Thesmar (forthcoming) suggests that the reason for this is that the tax affects both types of traders uniformly. They simulate a policy change in France that makes the cost of equity trading higher for retail investors (who are often regarded as noise traders) than for other investors and show that this would significantly reduce the volatility of stocks.

Hau (1998) also develops a theoretical model on the relationship between taxes and volatility. His model allows for endogenous entry of traders subject to heterogeneous expectational errors. Entry of a marginal trader into the market has two effects: it increases the capacity of the market to absorb exogenous supply risk, and at the same time it adds noise and endogenous trading risk. The competitive entry equilibrium is characterised by excessive market entry and excessively volatile prices. A positive tax on entrants can decrease trader participation and volatility while increasing market efficiency.

The models described above assume stochastic interaction between agents, who are assumed not to be able to influence aggregate variables. This assumption is questioned by HAM interaction models, which support the idea that even weak interactions between individuals can lead to large movements in aggregate variables. Follmer (1974) considers an exchange economy with random preferences based on a probability law which depends on the agents' environment. Using results on interacting particle systems from physics, he shows that even short-range interactions may propagate through the economy and lead to aggregate uncertainty causing a breakdown of price equilibria (Hommes 2006).

Kirman (1991) formalised a 'local interaction model' comprising two sub-models: a model of opinion formation through a stochastic model of recruitment and an equilibrium model of the foreign exchange rate. The model of opinion formation argues that there is individual behavioural asymmetry when facing symmetric events.[12] Applied to financial markets, Kirman assumes that agents have to form opinions about the next period price of a risky asset, and they can choose between an optimistic and a pessimistic view. The fractions of fundamentalists and chartists in the market are thus derived from a stochastic model of recruitment and then used in the foreign exchange rate model. Agents' expectations are influenced by random meetings with other agents. Agents have

11 See Xu (2010) for a model in which the excess exchange rate volatility caused by noise traders can be reduced by a Tobin tax, but the effect of the tax depends on the market structure and the interaction between the tax and other trading costs.

12 This idea originated from a puzzle observed in biology where ants, having to choose between two identical food sources, do not simply choose randomly. Rather, the majority of them chose one source, but their preferences for which source change over time.

to decide to invest in two different assets: a safe asset, namely domestic currency, paying a fixed interest rate; and a risky asset in the form of foreign currency paying an uncertain dividend. As usual, the equilibrium exchange rate is found where the aggregate demand for currency equals aggregate supply. If the market is dominated by fundamentalists, the exchange rate is stable and is pushed towards its fundamental value, causing low volatility. If noise traders dominate the market, the exchange rate is either driven by a stable but near unit root process, or by an unstable process when chartists think that the movement in the exchange rate will be greater than the risk-free asset return, leading to high volatility. In this way, local interaction models capture one of the most important stylised facts of financial markets, namely volatility clustering, in which the exchange rate switches irregularly between phases of high and low volatility.

Lux and Marchesi (1999, 2000) also attempt to derive a model capable of explaining the stylised facts of financial markets (e.g. asset prices follow a unit root process; asset returns are unpredictable with almost no autocorrelation; returns distribution has fat tails; volatility clustering).[13] They analyse the probability of traders switching from chartist to fundamentalist trading strategies as well as from an optimistic chartist strategy to a pessimistic one and vice versa. The equilibrium price is derived based on the composition of traders in the market and a market opinion index, which captures the average opinion among chartists. Volatility arises through the interaction of, and switching between, fundamentalist and chartist trading strategies. Periods of high volatility are associated with an increase in the number of chartists in a market with a balanced distribution of pessimistic and optimistic views.[14]

Another set of models has looked at the implications of imposing Tobin taxes on volatility when there is more than one market (e.g. London and New York). Westerhoff (2003) and Westerhoff and Dieci (2006) developed a simulation model of heterogeneous interactive agents in which rational agents apply technical and fundamental analyses for trading in two different markets. The technical analysis is based on past price trends, whereas fundamental analysis predicts a convergence towards fundamentals. The agents have several options, which are chosen depending on their relative fitness, where the fitness is given as a weighted average of current and past profits. Their model shows that even the imposition of a low tax rate of 0.25 per cent in one market reduces distortions and volatility in the taxed market, whereas the untaxed market experiences stronger bubbles and crashes and higher volatility than before. Their model therefore supports Tobin's hypothesis that imposing a tax will reduce volatility. Moreover, they conclude that 'there is no reason for regulators of a market not to impose such a tax – at least the own market will benefit', because 'if the agents have to pay a uniform levy in both markets, chartism declines in favor of fundamentalism in both markets and thus both markets display lower price fluctuations and deviations from fundamentals'(Westerhoff and Dieci 2006: 295). This also suggests that regulators in the untaxed, more volatile market may see it in their

13 See Lux (2009) for a recent general overview of how HAMs fit the stylised facts, such as clustered volatility, fat tails and long memory, of financial time series data.

14 Demary (2008) provides another model of chartist–fundamentalist interaction which replicates these stylised facts.

interests to also impose the tax in order to compete for investors with a longer-term horizon.

Finally, the market microstructure may influence the impact of an FTT (Honohan and Yoder 2009). For example, broker markets may react differently from dealer markets, and products characteristics might also influence the impact of taxation. Mende and Menkhoff (2003) suggest that asset managers are, most probably, the group with the heaviest influence on shorter-term exchange rate movements. They argue that there is no tax rate that could both influence their behaviour and simultaneously maintain the desired high level of liquidity, therefore concluding that no uniform proportional Tobin tax can achieve its objectives.

A recent model by Pellizzari and Westerhoff (2009) shows how the effectiveness of transaction taxes can depend on the market microstructure. In their model, heterogeneous traders use a blend of technical and fundamental trading strategies to determine their orders; they may also become inactive if the profitability of trading decreases. They find that, in a continuous double auction market,[15] the imposition of a transaction tax is not likely to stabilise financial markets since a reduction in market liquidity amplifies the average price impact of a given order. However, in a dealership market, abundant liquidity is provided by specialists and thus a transaction tax may reduce volatility by crowding out speculative orders.

2.1.4 Zero intelligence agent models

Another approach to modelling the behaviour of financial markets is through the use of 'zero intelligence' (ZI) models – so called because they assume that market traders in the aggregate, behave probabilistically rather than being driven by any intelligent maximising behaviour. Agents in these models place orders to buy and sell at random depending on the current price. Only the institutions (e.g. the auction process) in these models have some kind of intelligence since they let prices converge to equilibria. The idea behind this approach is that modelling market behaviour using minimally intelligent agents provides a good benchmark of the effect of the market institutions, since it shows what sorts of behaviour arise purely because of these institutions and not due to any intelligent or strategic behaviour on the part of the agents. It may well be that market institutions shape agents' behaviour so much that some properties of their behaviour depend more on the structure of these institutions than on any rationality on their part.[16]

ZI models are therefore much simpler than models assuming full rationality because they do not try to derive the properties of the market from assumptions of utility

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15 The continuous double action is the most widely used method of price formation in modern financial markets: 'double' because traders can submit orders to both buy and sell; and 'continuous' because they can submit orders at any time. Orders can be of two different types: limit or market orders. Limit orders are orders where the offered price does not match the ask price, so they do not result in an immediate transaction. Market orders match the ask price and therefore result in an immediate transaction.

16 Indeed, Gode and Sunder (1993) claim that if students in an economics classroom are replaced in an experiment by zero intelligence agents with a budget constraint, the behavioural results are almost the same!

maximising rational individual agents. Rather, the ZI models study the flow of liquidity in and out the market and its interaction with price formation. Interestingly, ZI models and models based on the rationality paradigm can give rise to quite different explanations for volatility. For example Hasbrouck and Saar (2002), using a rational optimising model, find a positive link between the ratio of market and limit orders and volatility. They explain that this is because, when prices are more volatile, market orders become more attractive to risk-averse rational agents (because, unlike limit orders, they entail an immediate transaction) and so the fraction of market orders increases. However, Farmer, Patelli and Zovko (2004), using a ZI model, show that the same relationship can be explained without any rational optimising behaviour. They show that a ZI model can exhibit a positive relationship between volatility and the ratio of market and limit orders due to the reduction of liquidity induced by the increase in market orders (since market traders are liquidity demanders), and that it is this reduction in liquidity that increases volatility.

Ehrenstein *et al.* (2005) used a ZI model to evaluate the impact of a Tobin tax on volatility, market distortions and government revenue, varying the size of the tax from 0 to 1 per cent. In this model, the introduction of a Tobin tax also brings about a reduction in volatility, as long as the tax rate is not so high as to significantly reduce market liquidity.

However, Mannaro *et al.* (2008) using a similar approach obtain a different result. They use a multi-agent simulation model to analyse the effects of introducing a transaction tax on one stock market and then on two related stock markets. The market consists of four kinds of traders (Raberto, Cincotti, Focardi and Marchesi 2003): random traders, who trade at random; fundamentalists, who pursue the 'fundamental' value; and chartists, who are either momentum traders (following the market trend) or contrarian traders (who go against the market trend). Each trader is modelled as an autonomous agent, with a limited stock portfolio and cash. When there are two stock markets, at each simulation step the trader decides in which market to operate by evaluating an attraction function for both markets.

Mannaro *et al.* find that the imposition of a tax in a single market of between 0.1 per cent and 0.5 per cent of transaction costs increases price volatility, as long as there are noise traders in the market. When there are two markets, volatility is higher as traders switch from one market to the other to try to reduce their risk. In this case, the taxed market is generally more volatile than the untaxed one because the tax reduces trading volume and market liquidity.

2.1.5 Game theoretical approaches

It is also possible to use game theory to assess the impact of a Tobin tax on volatility. For example, the grand canonical minority game (GCMG) model has also been used to analyse the effect of the imposition of a Tobin tax in the exchange rate market.[17] It is a stylised representation of the financial markets, which are depicted as an ecology of different types of agent, speculators and institutional traders, interacting in an 'information food chain' (Bianconi *et al.* 2009). As in previous models, it captures the interplay between commercial traders and

17 See Challet, De Martino, Marsili and Perez Castillo (2006) for a review of GCMG models.

financial speculators, with the latter group assumed to be responsible for both excess volatility and market efficiency. There are two types of agents. The first is commercial traders. They trade no matter what, so that the imposition of a tax cannot affect their choice. The second type of agent is financial speculators, who trade only if the perceived market profit exceeds a given threshold. The speculators keep score of the success of their previous strategies and adapt them accordingly. The main objective of each agent is to be in the minority, i.e. to place a bid which has the opposite sign of the aggregate bid of all agents.

Bianconi *et al.* (2009) analyse the impact of the imposition of a Tobin tax on the volatility of the exchange rate in a GCMG model. The first effect of the tax is to increase the profit threshold for speculators, discouraging them from trading. More generally, the effect of the tax depends on how close the market is to a critical zone of information efficiency. If it is far from this zone, the tax has a mild effect on volatility and information efficiency. If the market is within the critical zone and volatility is high, only a sufficiently large tax will have an impact on volatility. Moreover, the impact on volatility is found to be very dependent on the market size. Since volatility decreases with the size of market, the effect of a Tobin tax is much stronger in a small market than a bigger one. Finally, in a market in which the composition of agents is evolving, a tax can reduce volatility only if the rate of change in the composition of agents is slow.

2.1.6 Laboratory experiments

Closely related to the above theoretical papers, is an emerging literature that attempts to test these theories directly, by constructing laboratory experiments or simulated marketplaces. An early example of this is the work of Noussair, Robin and Ruffieux (1998). They use a continuous double auction model to explore the impact of an FTT on market efficiency and the volume of trade. They show that, despite the imposition of a small FTT,[18] prices are still driven towards their equilibrium level, although with reductions in market efficiency and turnover.

Similarly, Hanke, Huber, Kirchler and Sutter (2010) simulate two continuous double auction markets, denoted LEFT and RIGHT on which a foreign currency (Taler) can be traded for the home currency (Gulden). They analyse the effect of the imposition of a transaction tax (0.5 per cent of the transaction value) on one and then on both markets. In order to examine the persistence of the impacts, they also consider a scenario where the tax is abolished again, after its introduction. Where the tax is imposed on only one market, they find that volatility in the taxed market decreases when the market is large and liquid, but increases when the market is small and illiquid. Moreover, volatility on the untaxed market is reduced significantly as a consequence of an increase in liquidity as traders shift to the untaxed market. If a Tobin tax is introduced simultaneously on both markets, overall trading volume is reduced and price volatility remains unchanged. Finally, they argue that the effects of a Tobin tax, once introduced on a market, cannot be completely undone by abolishing the tax later on, since the pre-tax level of trading activity would not be restored.

18 The tax was= 50 yen (200 yen = 1 French franc). This tax was charged to any agent who submitted an offer to buy or sell to the market.

Table 2.1 Results from selected theoretical and simulation models

Author(s)	Impact of Tobin tax on volatility
Hanke *et al.* (2010)	Increase or decrease depending on market size
Shi and Xu (2009)	Increase or decrease depending on the effect on the number of noise traders
Westerhoff (2003) and Westerhoff and Dieci (2006)	Decrease
Ehrenstein (2002); Ehrenstein *et al.* (2005)	Decrease, as long as the tax rate is not too high to affect the liquidity
Mannaro *et al.* (2008)	Increase, but only in presence of noise traders in the market
Kaiser *et al.* (2007)	Decrease
Bianconi *et al.* (2009)	Decrease but depending on market size
Bloomfield *et al.* (2009)	Little effect on volatility
Hau (1998)	Decrease
Pellizzari and Westerhoff (2009)	Decrease in highly liquid dealership markets; no effect in limit order markets

Source: Authors' own

Kaiser *et al.* (2007) describe a game theoretical approach applied to an asset market both with and without the introduction of a Tobin tax. The game was set up with two steps. In the first step, agents define their bid and ask prices. Market prices are then created, with the ask price as the lowest stated by agents and the bid price as the highest. In the second step, each agent decides whether to buy or sell or to refrain from trade. When a tax is introduced, it is paid by the agent who initiates the trade and is a percentage of the bid or ask price. In addition, the tax's height is varied to analyse the elasticity of volatility with respect to the tax. In the final period the assets each agent holds are converted into money.

Using this framework Kaiser *et al.* (2007) carried out experiments on 96 subjects, mostly students from the University of Bonn. They analysed six sessions for the taxed scenario and six sessions for the untaxed one, each session lasting two hours. In general they found that the Tobin tax reduced volatility, relative to the untaxed market.[19] However, a tax rate above 2 per cent increased volatility drastically in their experiment, although the statistical evidence is not strong enough to give a definitive conclusion on this.

Cipriani and Guarino (2008) also elaborate a theoretical and experimental paper on the negative effects of transaction costs, such as a Tobin tax, on price discovery. In their model, informed and uninformed traders trade in sequence with a market maker and pay a cost to trade. They show that, eventually, all informed traders decide not to trade when transaction costs are imposed, independently of their private information, i.e. an 'informational cascade' occurs. When they

19 Unlike most studies, they measure variance as the absolute difference between prices and their mean.

replicated their financial market in the laboratory, they found that informational cascades occurred when the theory suggested that they should.

As the above discussion makes clear, there are a wide range of theoretical models with different assumptions and different results. Table 2.1 provides a summary of the conclusions from the key theoretical papers on the topic. Most, but not all, studies conclude that a small Tobin tax would reduce volatility, but many models also suggest that great care should be taken in choosing the size of the tax since, if it is too large, the reductions in market trading and liquidity could result in an increase rather than a reduction in volatility (Song and Zhang 2005).

2.2 Empirical evidence

Theoretical models, and their associated simulations, are helpful in thinking through the pathways through which a Tobin tax might affect volatility, but we cannot be sure that real financial markets will necessarily behave in the way that these models predict. It is therefore helpful to look at empirical evidence about the impact of such taxes. Unfortunately, there are relatively few such empirical studies, in part because a Tobin tax has not yet been imposed. However, other similar taxes have been imposed in various countries and so it is possible to learn from these experiences. Moreover, there is a literature on the relationship between transaction costs and volatility. In so far as taxes increase transaction costs, this literature can shed light on the possible effects of a Tobin tax.

Most of the studies examining the link between transaction costs and volatility find a positive relationship between the two – that is, higher transaction costs are associated with more, rather than less, volatility. For example, Mulherin (1990) examines trading costs in the New York Stock Exchange (NYSE) and relates these to the daily volatility of the Dow Jones returns over the 91 years from 1897 to 1987. He concludes that although the imposition of a transaction tax can be expected to be followed by lower trading volume, a corresponding decline in volatility is not an obvious result.

Other studies on stock markets give similar results. For example, Jones and Seguin (1997) show that the abolition of mandated minimal commission rates in the USA in 1975 decreased transaction costs in the NYSE and the American Stock Exchange (AMEX) markets and that market volatility fell in the year following the deregulation. The decrease in volatility was larger than the reduction in volatility registered for the NASDAQ market (which had not experienced the deregulation). This suggests that it was the deregulation that gave rise to the drop in volatility rather than the overall reduction in market volatility, although it is possible that some other aspect of commission deregulation (beyond the transaction cost decline) was responsible for the volatility decline. Similarly, Atkins and Dyl (1997) find that volatility and transaction costs are positively related, suggesting that a securities transaction tax (STT) could impede the adjustment of stock prices to new information, rather than curb short-term speculation.

Liu and Zhu (2009), following Jones and Seguin's approach, study the effect of the commissions deregulation which occurred in October 1999 in the Japanese market. These were part of the 'Big Bang' reforms in which STTs were abolished and the fixed brokerage commission deregulated. The main aim of the reform was to reduce transaction costs, blamed for the economic stagnation and the poor performance of the Japanese equity market during the 1990s. In contrast to Jones and Seguin, they find support for the idea that the reduction in transaction costs increased volatility in the Tokyo Stock Exchange.[20] Since there was no section of the Japanese market exempt from the reforms, they compare a treatment group, TOPIX (a value weighted stock price index covering the Tokyo Stock Exchange (TSE) First Section and its three subgroups), with four control portfolios: American Depositary Receipts (ADR), which is used as the benchmark control portfolio, and three equity indices for Asia (AEJ), Pacific (PEJ) and Asia/Pacific (APEJ), respectively.[21] The control portfolios are strongly linked to the treated portfolio, but are not affected by the commission deregulation. Liu and Zhu's results show that volatility for TOPIX increased by 32 per cent after the deregulation, relative to the control portfolios.

Bessembinder and Rath (2002) analyse stocks moving from the NASDAQ market to the NYSE. They find strong evidence that the newly NYSE-listed stocks reduce both trading costs and the standard deviation of daily returns. But NYSE listings may simultaneously alter market structure or investor composition, which may affect volatility. Hence the cross-market comparison is inconclusive because the volatility change could result from a stock-listing effect rather than a transaction cost effect.

Studies of tick size[22] changes tend to give the same result. Larger tick sizes are associated with higher transaction costs and also with higher volatility (Bessembinder 2000). Similarly, Hau (2006), studying French stock, finds that a larger tick size increases transaction costs by 20 per cent and that this increase in transaction costs generates an increase in volatility of about 30 per cent. However, it is not clear whether the types of transaction costs introduced by tick size changes would act in the same way as a transactions tax.

Studies of foreign exchange markets also suggest that higher transaction costs are associated with greater volatility. Aliber, Chowdhry and Yan (2003) look at transaction costs, volatility and trading volume using futures prices of four currencies (the British pound, the Deutschemark, the Japanese yen and the Swiss franc) traded on the Chicago Mercantile Exchange for the period 1977–99. Average transaction costs are tiny – in the range of $36 to $51 for a foreign currency trade valued at $100,000 (i.e. around 0.05 per cent). Across the four currencies, the average volatility is 11.025 per cent.[23] They find that an increase of 0.02 per cent in transaction costs leads to an increase of volatility of 0.5 percentage points, as well as a reduction in trading volume.

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20 The authors identify two reasons for the different effects in the USA and Japan: first, the commission deregulation in Japan drastically reduced the commission rates on individual trading, while the opposite was true for the deregulation in the USA; second, online retail stock trading, which was unavailable at the time of the US deregulation, has further fuelled individual trading following the Japanese deregulation.

21 Japan was excluded from all of the three control indices.

22 The tick size is the minimum price change allowed in the trading system. This can depend on the value of the stock, with higher valued shares having larger tick sizes.

23 They measure volatility as the standard deviation of daily returns on the closest maturing futures contract.

Lanne and Vesala (2010) confirm this finding with both daily and intra-daily data on Deutschemark–dollar and yen–dollar exchange rates from 1992 to 1993. They include money market headline news on the Reuters AAMM screen to control for the endogeneity problems caused by changes in fundamental volatility. Following Andersen and Bollerslev (1998), they compute volatility as daily realised variance summing the squared 5-minute returns over each trading day. Realised variance is regressed on transaction costs and a set of control variables. They estimate both daily and intra-daily equations, because transaction costs can vary in the course of a day. The results show that both in the daily and intra-daily regressions the effect of transaction cost on volatility is positive and significant. An increase of 0.01 per cent in transaction costs raises the variance of the Deutschemark by 1.16 per cent relative to its average; the increase for the yen is 1.21 per cent, over four times larger than the increase calculated by Aliber *et al.* (2003). The difference in findings from Aliber et al is due to their use of better controls for endogeneity, as well as their use of higher frequency data.

Turning to the few studies of actual transaction taxes, we find a similar story. Roll (1989) analysed the impact of the imposition of a transaction tax on volatility in 23 equity markets around the world, in three periods before and after the international equity market crash on October 1987. He found that transaction taxes were inversely but insignificantly related to volatility both before and after the crash. Also, Hu (1998), who describes 14 changes in STT rates that occurred in Hong Kong, Japan, Korea, and Taiwan during the period 1975–94, concludes that, on average, a change in STT rates had no effect on volatility.

Similarly, Sweden introduced a 1 per cent round trip tax on equity transactions in 1984, which was increased to 2 per cent in 1986. Umlauf (1993) compares weekly and daily returns variance of the Swedish All-Share Equity Index under the no tax, 1 per cent and 2 per cent tax regimes. He finds no significant difference in the weekly variance across the three tax regimes.[24] There is, however, a statistically significant increase in the daily variance of returns, which is higher during the 2 per cent tax regime than in the other regimes (regardless of whether the 1987 crash is included or not). Umlauf also attempts to control for time varying fundamental volatility, by normalising the returns variance by the NYSE and FTSE All-Share Index[25] variances, but finds no systematic relationship between tax regime and volatility.

Since the stocks of some Swedish firms were also traded in London, Umlauf (1993) also attempts to assess the impact of the tax by calculating the ratio of the volatility of London- and Swedish-traded share classes. If this ratio diminishes with the imposition of the tax, it would suggest that transaction taxes increase volatility. He shows that this ratio falls or remains stable across the different tax regimes for 9 out of 11 companies for daily data and 5 out of 11 for weekly data. The average reduction was about 6 per cent on a daily basis and 2 per cent on a weekly basis, supporting the idea that the imposition (and increase) of the transaction tax increased volatility in the taxed market. Umlauf also notes that the tax gave rise to huge market diversion from the Swedish to the London stock market. It was

24 If the period of the 1987 crash, which occurred at the end of the period studied, is excluded.

25 FTSE is an independent company jointly owned by the Financial Times and the London Stock Exchange.

estimated that, in 1986, 30 per cent of Swedish trading was diverted to London; by 1990 the migrated volume had grown to 50 per cent (Campbell and Froot 1994).

Saporta and Kan (1997) undertake a similar piece of analysis on the impact of the imposition of UK stamp duty on the FTSE All-Share Equity Index returns from 1969 to 1996. Unsurprisingly, they find that the increase in stamp duty rate from 1 per cent to 2 per cent in 1974 caused a significant (-3.3 per cent) fall in the index, whilst its reduction from 2 per cent to 1 per cent in 1984 and then to 0.5 per cent in 1986 caused a small increase. To disentangle the effect of the STT on volatility, they compared the variance of returns on the stock of four companies listed on the London Stock Exchange, which are subject to the stamp duty, with the returns variance of their corresponding US-listed ADR, which are not subject to stamp duty. Using univariate GARCH and ARMA models with different specifications to control for serial correlation and the leptokurtotic distribution of financial time series, their findings show no significant effect of UK stamp duty imposition on the volatility of equity prices.[26]

More recently, Phylaktis and Aristidou (2007) describe the effect of an STT increase and reduction in the Athens Stock Exchange (ASE). First introduced in 1998 at 0.3 per cent, it was increased in 1999 to 0.6 per cent and then reduced after two years to its original rate. Phylaktis and Aristidou use the All-Share Index as well as the FTSE/ASE 20 Index, which covers the top 20 shares, to test whether the transaction tax had a greater impact on the volatility of the most actively traded stocks. Unlike previous studies, they control for the possibility that transaction taxes might have a different effect on volatility during bull and bear periods.[27] They also test whether negative shocks (bad news) raise volatility more than the positive ones (good news), which might induce future stock volatility to vary inversely with the stock price.

Their results show that the transaction tax has no effect on volatility for both the All-Share Index and the FTSE/ASE 20. The STT decreases volatility in bull periods and increases it in bear periods for FTSE/ASE 20. Phylaktis and Aristidou (2007) argue that the STT reduces volatility in bull periods because investors are less affected by transaction taxes in highly liquid markets and instead buy stocks in anticipation that the market will continue to rise. They suggest that the reverse effect during bear periods is because investors become more price sensitive to the additional cost of the transaction tax.

Su and Zheng (2011) analyse the impact of changes in STT rates in the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE), on trading volume, volatility of returns and market efficiency. Both exchanges list two types of shares, A and B shares, issued by Chinese companies. An STT on both purchase and sale of A shares was introduced in 1991 and modified 14 times between then

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26 See Oxera (2007) and Bond, Hawkins and Klemm (2005) for studies of the broader impact of stamp duty.

27 'A bull or a bear market is a period of consecutive monthly increases or decreases in stock prices whose horizon is perceived to last more than one month. That is, a period during which there are at least n consecutive monthly stock returns with the same algebraic sign. Because there is no widely accepted definition of a bull or a bear period, the horizon n of our analysis takes three possible values, n=3–5 months' (Phylaktis and Aristidou 2007: 1459).

and 2008. Their results suggest that both an increase and a decrease of the STT increases volatility. Moreover, although the evidence on market efficiency is mixed, the effect of the tax on trading volume is clear: an increase of the rate (on average by 133 per cent) decreased trading volume (by 26 per cent), whereas reducing the tax rate (on average by 50 per cent) increased volume (by 105 per cent). Su and Zheng suggest that increasing the STT boosted volatility because it reduced the frequency of transactions and the volume of trade, thereby shrinking liquidity and widening bid-ask spreads. However, reducing the STT also increased volatility. Su and Zheng suggest that this is because trading volume may be a proxy for information flows. The decrease in transaction costs may therefore have increased noise trading inducing higher volatility.

Finally, Chou and Wang (2006) examine the impact of the decision by the Taiwanese government in 2000 to reduce the tax levied on futures transactions on the Taiwan Futures Exchange from 5 to 2.5 basis points. Using intra-day and daily time series data from 1 May 1999 to 30 April 2001, they show that transaction taxes have a negative impact on trading volume and bid-ask spreads, as trading volume increased and bid-ask spreads decreased in the period following the reduction in the transaction tax. Moreover, they found no significant changes in price volatility after the tax reduction.

It is important to note that the empirical literature reviewed above suffers from a number of methodological weaknesses. First, studies use a range of different measures of volatility, making it hard to compare the results across studies. Studies also use different levels of data aggregation, which again can give rise to differing results, although there seems little theoretical reason for using one level of aggregation over another.

Second, all of the empirical studies focus on day-to-day (or shorter period) volatility. However, such short-run fluctuations may not matter very much to the broader economy. By contrast, crashes and major market adjustments can have significant and long-lasting effects. Indeed Tobin's original intent was that the tax should help to make exchange rates reflect long-term fundamentals, rather than short-run volatility. Theoretically, a tax on transactions might discourage equity financing in favour of bank financing. If reliance on bank financing creates greater systemic instability than equity financing, an FTT might increase the probability of crashes. At the same time, if a tax was successful in discouraging destabilising trades, then it could reduce this probability. Unfortunately, to our knowledge, there are no papers which look at the impact of FTTs on the probability of a crash or adjustment taking place (the nearest paper is that by Roll (1989) discussed above). We see this as a major gap in the literature.

Finally, even if only considering short-run volatility, it is important to control for market-wide changes in volatility. Although there is no consensus on the best methodology for doing this, there are clear differences in the quality of methodology within the literature. Generally, cross-sectional stock-level studies (e.g. Bessembinder and Rath 2002; Hau 2006) have much more statistical power and, by exploiting natural experiments, a more rigorous way of dealing with endogeneity than older studies.

Nonetheless, the overall conclusion from the empirical evidence is more one-sided than the theoretical work. The balance of evidence suggests that there is a positive relationship between transaction costs and volatility, although the size of this effect varies across different studies. Whether a Tobin tax would affect volatility in the same way as underlying market transaction costs is not clear. The Swedish experience of imposing a tax on equity transactions may have increased volatility, but the size of the tax was large; there is no evidence that UK stamp duty had any effect on volatility, although it clearly affected returns on equity.

3 Is a financial transaction tax feasible?

Many of the arguments typically levelled against the introduction of FTTs are practical concerns related to the ability to implement such taxes in an effective fashion (Reisen 2002). There is now a substantial literature on these implementation issues. This literature addresses the two core implementation concerns of substitution (the potential for market actors to shift away from taxed instruments to untaxed instruments) and migration (the ability of market actors to shift their activities to untaxed locations). The literature has tackled the issue of substitution by exploring the question of which instruments should be taxed and at what rate. The issue of migration requires asking at what the point in the financial system the tax should be imposed, as well as whether multilateral cooperation is necessary in order to implement a successful tax. We explore each of these questions in turn below.

3.1 Which instruments should be taxed?

Tobin's original idea in 1972 was to tax spot transactions in the traditional foreign exchange markets. However, the problem with this approach is immediately obvious – there is little difference between a transaction in the spot market and the forward market. Hence, if a tax were to be imposed only on the spot market, we would expect to see a large reduction in the volume of trade in that market and a corresponding increase in the market for close substitutes. Such a tax might still be valuable if such a change in the structure of the market were to bring about a reduction in volatility (see the discussion in Section 2), but it would be almost certain to reduce substantially the revenue from the tax.

As a result of this, Kenen (1996) argues that, if a tax on spot transactions were implemented, short-term forward contracts would have to be taxed as well, because of the high substitutability between the two instruments (see also Tobin 1996). However, since swap contracts are composed of combined spot and forward transactions, this would suggest that they should also be taxed, although as one transaction.[28] Similarly, it would then be necessary to include interest-rate swaps. Pollin (2005) argues that swap transactions can be considered as equivalent to the transfer of ownership of an asset. The main difference is that the parties exchange claims on the income stream on two separate assets, instead of

28 However, if this is the case then synthetic swap contracts, which are composed of spot and forward contracts but with two different counterparties, will be taxed twice.

exchanging the assets themselves. He therefore suggests taxing the value of the underlying asset each year until the asset's maturity.

If swaps are included in the tax base, what about futures? Here, there is more dissent in the literature. Kenen (1996) suggests taxing these on the notional value of the contract when written and traded, leaving the collection to the point of trade. Similarly, Pollin (2005) suggests taxing the notional value of the underlying assets of a future contract, following the Japanese approach, in order to make the size of the tax proportional to the size of transaction. However, others have cast doubt on the feasibility of taxing futures. Stephany Griffith-Jones (1996) stated that, since the changes in the cash flows in futures contracts relate not to the nominal value but to contract's value, a tax of 0.5 per cent on the nominal value could completely destroy the futures markets. However, more recently she has argued that the changes in the foreign exchange market over the last 15 years, including much greater usage of derivatives and regulatory moves to bring trades onto exchanges, makes it far more feasible to tax futures now (Griffith-Jones pers.comm. 2010). At the same time she suggests that the dramatic reduction in the typically proposed size of the tax (to 0.005 per cent) would make strong negative effects much less likely.

If future contracts are taxed, this naturally raises the question as to whether options should be taxed too. However, options are particularly difficult to include since they may never be exercised in the spot or forward markets. Moreover, if they were taxed, substitution with synthetic options and more complex contracts would seem very probable. On the other hand, if exempted, options could crowd out forward and future markets. Stiglitz (1989) therefore suggests including options, but taxing them at half the tax rate applied to the underlying assets. Alternatively, Pollin (2005) suggests taxing the premium paid for the option, i.e. the price paid for acquiring the option. The rationale here is that taxing the premium taxes the asset actually traded with option contracts (i.e. the right to acquire another asset). Moreover, unlike the strike price, the premium incorporates the markets' evaluation of the option itself, including the time limits to exercise the option and the difference between the strike price, the market price of the underlying asset at the time of the purchase and the price history of the underlying asset.

Whether the omission of futures and options would have a significant impact upon the revenue raised from an FTT depends on the extent to which FTTs are used by importers and exporters for hedging, or whether their use is predominantly to profit from speculation on exchange rate changes without actual delivery of the currencies. If the former predominates, futures and options will translate into eventual spot market transactions which would be taxed, but this would not be the case if the primary motive for the use of such instruments was speculative (Kenen 1996). Similarly, Eichengreen and Wyplosz (1996) suggest that it is necessary to tax only spot transactions, since, when a foreign currency asset is sold to a non-financial customer, the bank finds itself with an open position in that currency. Risk management practices dictate closing that position by buying the same amount of currency from another bank. If the bank cannot find this currency in other banks, it will buy it from the spot markets. Thus they argue that authorities can affect the entire chain by taxing only the spot market.

Finally, if an FTT is applied beyond the foreign exchange market, the question arises as to whether it should include bonds. Pollin (2005), for example, includes all government debt (federal, state and municipal in the case of the USA) in order to minimise any distortionary effects on the tax across the markets. On the other hand, several commentators point to the common practice of excluding transactions in government bonds from taxation in order not to raise the costs of government borrowing.

Notwithstanding this, the general consensus in the literature is that the tax base for an FTT should be broad, including equities, bonds, futures, options and interest-rate swaps (Palley 2003). For example, Baker, Pollin, McArthur and Sherman (2009) argue for full coverage in the traditional and non-traditional market. Schulmeister (2009) deepens this coverage to include also over the counter (OTC) derivatives, including interest rate-, foreign exchange-, equity-, commodity-, and credit related derivatives, as well as credit default swaps (CDS). On the other hand, Jetin (2009) does not include exchange or OTC derivatives in the design of his currency transaction tax.

3.2 Should the tax rate be uniform for all instruments?

If an FTT is to cover more than one instrument, the question naturally arises as to whether all instruments should be subject to the same tax rate. Campbell and Froot (1994) suggest that the optimal tax should abide by two principles:

1. Transactions which give rise to the same patterns of pay-offs should pay the same tax.
2. Transactions which use the same resources should pay the same tax.

The aim of the first principle is to avoid substitution between different instruments. However, in practice, Campbell and Froot argue that it is extremely difficult to implement. As is well known, derivatives deliver pay-offs which can be replicated through trading the underlying assets. Thus the pay-off pattern obtained by purchasing and holding an option can be replicated by undertaking a dynamic trading strategy in the underlying asset and vice versa. However, once a transaction tax is imposed, some pay-off patterns will be cheaper to achieve with derivatives and others will be cheaper to achieve with the underlying assets. Transaction taxes will generally not be able to equate the tax burden from trading the two instruments (Campbell and Froot 1994).

Campbell and Froot's second principle of transaction taxes requires equating the tax burden across assets as a fraction of total transaction costs, so that transactions with the same resource costs would be taxed at the same rate. There are three ways in which this principle can be implemented: taxing the transaction directly, taxing the notional amount invested at a lower rate for assets with lower transaction costs and, finally, taking into account not only direct 'resource costs' but also indirect ones, such as negative externalities in the financial markets including excessive volatility of asset prices, higher risk premiums and excessive or misallocated investment in speculative activities.

The detailed elaboration of securities transaction taxes for the US financial market by Pollin, Baker and Schaberg (2003) adopts a similar set of principles. They suggest that the tax rate has to be smaller, or at least in the same range, as the transaction costs for each instrument. Based upon a set of estimates of market transaction costs for different instruments, they suggest applying:

- 50 basis points[29] for equities,
- 1 basis point for bonds per each year until bond's maturity,
- 2 basis points of the notional value of underlying asset for futures,
- 50 basis points of the premium paid for options,
- 2 basis points per year until maturity of the swap agreement for interest rate swaps.

We adopt a similarly differentiated approach in our own revenue estimates (see Section 4).

Moreover, a recent report on FTTs prepared for the European Parliament (Darvas and von Weizsäcker 2010) suggests that higher tax rates should be imposed for OTC derivative transactions than for exchange-based derivative transactions, on the grounds that OTC transactions are less transparent and subject to greater systemic risks. Thus it is argued that differential tax rates could complement the ongoing legislative actions to encourage centralised clearing for derivatives.

3.3 Should taxation be national or market-based?

A further implementation issue concerns whether the tax is collected on a national basis or a market basis. The former implies that financial institutions pay the proceeds of the tax from all their dealing sites across the world to the country in which they are headquartered. By contrast, collection on a market basis means that governments would collect the tax on transactions of all players within their country, whether domestic or foreign.

Kenen (1996) argues that, although the national basis is ideal – because it would discourage migration of transactions to tax-free sites – it suffers from four important disadvantages:

1. It would create an extra burden for banks because they would have to consolidate data from all of their dealing sites and send them to their headquarters.
2. It would create an incentive to enforce laws on data confidentiality in order to create tax-free locations by preventing banks from sending data to their head offices.
3. It would favour those banks whose home countries do not impose the tax. These banks would end up having a comparative advantage both at home and abroad.
4. It would disfavour large financial centres, such as the UK, where the market is bigger than the total transactions by British banks.

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29 1 per cent = 100 basis points.

Conversely, collection on a market basis has the advantage that it does not create a competitive disadvantage for institutions from the home country, but it does encourage the creation of tax-free locations and the migration of dealing sites to these places.

Offshore migration has been addressed by Summers and Summers (1989) in their discussion of the design of a securities transaction excise tax (STET) in the USA. They argue that the problem could be solved through two strategies:

1. Harmonisation of the STET structure and enforcement among countries that are financial centres.
2. Imposition of the tax on transactions occurring outside the USA but involving US persons as principals, on a residency, rather than a situs, basis.

They also suggest partial exemption of transactions by foreigners within the USA to avoid any negative effect on the competitiveness of the US market for foreign participants.

By contrast, Pollin (2005) proposes applying a US STET to all traders in US financial markets, both domestic and foreign residents. In addition, Pollin argues that the tax should be applied to the foreign transactions of US nationals and corporations as well as to trades of US securities by foreigners in non-US markets.

In conclusion, there is no firm consensus on whether a national or market basis is preferable for implementation. Indeed many possible permutations are possible depending on the nationality of the asset being traded (e.g. a US or a UK security), the nationality of the trading parties and the market in which the trade takes place. Unilateral imposition of a tax on a national basis disadvantages home country financial institutions relative to their competitors. However, unilateral imposition of a market basis tax encourages both domestic and foreign firms to migrate elsewhere. This suggests that market-based implementation would require the agreement of at least the major financial centres. Implementation on a national basis, however, could be undertaken unilaterally, but might entail a significant political cost (Dodd 2003; Weaver, Dodd and Baker 2003).

3.4 At what point in the system should the tax be imposed?

Another practical concern about the implementation of an FTT is the issue of where within the financial system the tax would actually be imposed. Kenen (1996) describes the steps and locations of transactions in the wholesale foreign exchange (forex) market. The first step is in the dealing sites where the deal is struck between two counterparties. The two dealers can be located in the same or different markets. They define the quantities, the place of booking and the place of settlement of the agreement. The second step is in the booking sites – each dealer will book the deal in an office of his or her bank. The last step is in the settlement sites, in which the bank balances are transferred between the banks. An exchange between two currencies entails two settlement sites. Kenen (1996) argued that the tax could be applied only at dealing sites. The possibility of moving banks' booking offices offshore prevents the use of the booking site. Moreover, because many transactions are netted before they are settled, he argues that it is not possible to separate out the subset of interbank transfers that arise from foreign exchange trades, making levying the tax on the settlement sites impossible.

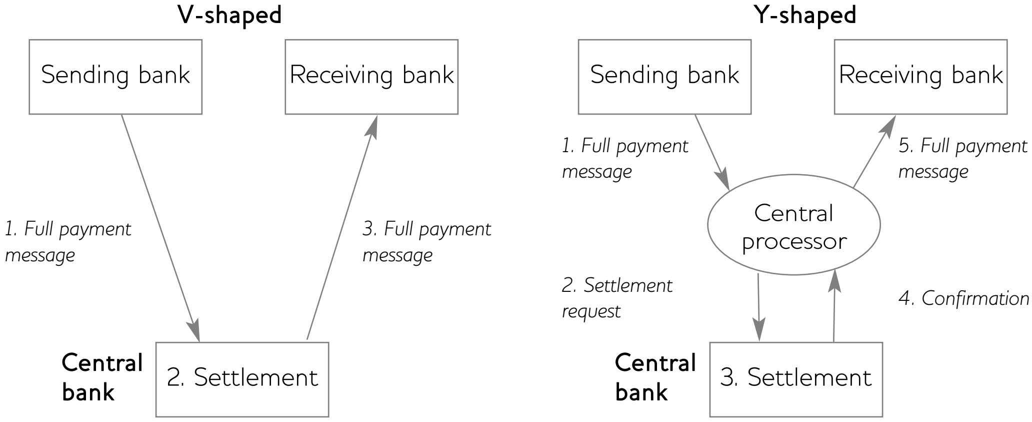
However, foreign exchange markets have changed considerably since Kenen's 1996 contribution, with a strong shift towards centralisation, formalisation and regulation of settlement sites. As a result, the primary practical objection that Kenen raises to applying the tax at settlement has much less force, since gross transactions can be now be effectively isolated. All financial and foreign exchange settlement systems, whether on- or offshore, require an account with the central bank that issues the currency in which the gross transaction is denominated. Moreover, the Continuous Linked Settlement (CLS) Bank, launched in 2002, now settles more than half of all foreign exchange transactions, eliminating settlement risk.[30] The remainder is processed through national real-time gross settlements (RTGS). Both of these systems allow a one-to-one correspondence between foreign exchange payments and their originating trades (payment-versus-payment (PvP) for exchanges of bank balances; delivery-versus-payment (DvP) for exchanges of securities) Moreover, the messaging and netting system, SWIFT, is more or less universally adopted so that central banks can enforce the tax on offshore netting systems and on derivatives such as contracts for difference (CfD) (Schmidt 2008). As a result, Schmidt (2000, 2008) and Spratt (2005, 2006) argue that the tax can be levied at the settlement sites, because they are now formal, organised and centralised.

Schmidt and Spratt also argue that levying the tax at settlement sites would considerably reduce concerns about tax avoidance because the global settlement systems provide an electronic track of every transaction, including options and other derivatives. Moreover, avoiding the tax by moving away from the use of centralised global systems such as CLS would be extremely expensive and probably ineffective. Spratt (2005, 2006) estimates that the net benefit from participation in the CLS for sterling or euro transactions is $17.94 billion annually.[31] He calculates that this is more than 17 times (for UK sterling) and around 8 times (for the euro) the tax payment that would be incurred through a 0.5 basis point levy on single currency transactions. Furthermore, even if banks did set up an alternative settlement system, it would have to be acceptable to central banks and compatible with Basel III and anti-money-laundering regulations. To comply with these regulations it would have to have very similar features to CLS and national RTGS systems. If these regulations were to require the implementation of the tax, it would not be possible to avoid the tax through establishing a new settlement centre. Applying the tax at the point of settlement also has the advantage that it

30 Settlement risk is also called 'Herstatt Risk'. On 26 June 1974 at 15:30 CET, the German authorities closed Bankhaus Herstatt, a middle-sized bank with a large forex business. Prior to the closure, however, a number of Herstatt's counterparty banks had irrevocably paid Deutschemark into Herstatt but, as US financial markets had just opened, had not yet received their dollar payments in return. This failure triggered a ripple effect through global payment and settlement systems, particularly in New York. Ultimately, this fed into New York's multilateral netting system, which over the next three days, saw net payments going through the system decline by 60 per cent (BIS 2002, as reported by Spratt 2005).

31 The benefit is the sum of efficiency gains, operating cost gains and net funding requirement gains.

Figure 3.1 V- and Y-shaped message flows in settlement systems



Source: BIS (1997). Reproduced with kind permission of MED-Publications

would avoid discriminating between on- and off-exchange trading. UK HM Treasury (2009), for example, argues that a financial transaction tax would have to be 'non discriminatory' between on- and off-exchange trading, to avoid diversion to off exchange.

Taxing at settlement sites is not without its difficulties. One concern is that, if such a tax were applied to transactions processed through CLS Bank, then there would be an incentive for banks to move transactions away from these safer and more transparent centralised clearing mechanisms. To avoid this, the tax would have to be applied to participating countries' RTGS systems. However, not all of these systems pass on the full information about each transaction to the point of settlement. Whilst CLS and TARGET (Trans-European Automated Real-time Gross Settlement Express Transfer, the EU RTGS system) both use V-shaped messages to convey the full information about a payment from sending to receiving banks, most RTGS systems use Y-shaped messages (Figure 3.1). In the latter, the information sent to the settlement body is filtered (usually by SWIFT) so that it contains only the details necessary to settle the transaction. For example, if French bank A buys yen against euros from another French bank B (where both are located in France), it will send the full information about this transaction to SWIFT. Bank A will then send euros to bank B through the French national payment system to settle the euro leg of the transaction (whilst their Japanese correspondent banks transfer yen between them). However, all the French settlement system knows in this case is that it has debited bank A's account by a certain amount of euros to credit the account of bank B. It does not necessarily know who the final beneficiary is, or whether the transfer of euros is one side of a forex transaction, the cash leg of a security transaction, or one leg of a money market transaction. This is because the French RTGS has adopted a Y-shaped structure. Only SWIFT possesses the complete information set included in the message (Jetin and Denys 2005: 107).[32]

32 See European Commission (2006) for a discussion of the barriers to tax collection on cross-border settlement.

Table 3.1 Transaction taxes around the world

Country	Stocks	Corp Bonds	Govt Bonds	Futures	Detail
Argentina	0.6%	0.6%	0.6%	0.6%	Tax of 0.6% on all financial transactions approved by legislature March 2000
Australia	0.3%	0.15%	–	–	Reduced twice in 1990s: currently 0.15% each for buyer and seller
Austria	0.15%	0.15%	–	–	Present
Belgium	0.17%	0.07%	0.07%	–	Present
Brazil	0.3% [0.38%]	0.3% [0.38%]	0.3% [0.38%]	–	Tax on forex from 2% to 0.5% in 1999. Tax on stocks increased and bonds reduced 1999
Chile	18% V	18% V	–	–	Present
China	0.5% or 0.8%	[0.1%]	0	–	Tax on bonds eliminated 2001. Higher rate on stock exchanges applies to Shanghai
Colombia	1.5%	1.5%	1.5%	–	Introduced 2000
Denmark	[0.5%]	[0.5%]	–	–	Reduced in 1995, 1998. Abolished 1999
Ecuador	[0.1%]	[1.0%]	–	–	Tax on stocks introduced 1999, abolished 2001. Tax on bonds introduced 1999
Finland	1.6%	–	–	–	Introduced 1997, applies only to trades on HEX electronic exchange
France	0.15%	See note		–	Present. Sources ambiguous as to whether tax applies to bonds
Germany	[0.5%]	0.4%	0.2%	–	Removed 1991
Greece	0.6%	0.6%	–	–	Imposed 1998, doubled 1999
Guatemala	3%	3%	See note		Present. Source ambiguous as to whether tax applies to government bonds
Hong Kong	0.3% + $5 SF	[0.1%]	[0.1%]	–	Tax on stocks reduced from 0.6% in 1993. Tax on bonds eliminated 1999. $5 stamp fee (SF)
India	0.5%	0.5%	–	–	Present
Indonesia	0.14% +10% V*	0.03%	0.03%	–	*VAT on commissions. Introduced 1995
Ireland	1.0%	–	–	–	Present
Italy	[1.12%]	–	–	–	Stamp duties eliminated 1998
Japan	[0.1%], [0.3%]	[0.08%], [0.16%]	–	–	Renewed 1999
Malaysia	0.5%	0.5%	0.015% [0.03%]	0.0005%	Present
Morocco	0.14% +7% V	7% V	7% V	–	Present
Netherlands	[0.12]	[0.12]	0	–	1970–1990
Pakistan	0.15%	0.15%	–	–	Present
Peru	[0.1%], 0.08% + 18% V	[0.1%], 0.08% + 18% V	[0.1%], 0.08%	–	Present

Table 3.1 Transaction taxes around the world (cont.)

Country	Stocks	Corp Bonds	Govt Bonds	Futures	Detail
Philippines	[0.5%] + 10% V	–	–	–	VAT present
Portugal	[0.08%]	[0.04%]	[0.008%]	–	Removed 1996
Russia	0.08%† – 8% V	–	–	–	†0.8% on secondary offerings. Present
Singapore	0.05% + 3% V	–	–	–	Reduced 1994, eliminated 1998. VAT present
South Korea	0.3% [0.45%]	0.3% [0.45%]	–	–	Reduced 1995
Sweden	[1%]	–	–	–	Removed1991
Switzerland	0.15%	0.15%	0.15%	–	Present 0.3% on foreign securities. 1% new issues
Taiwan	0.3% [0.6%]	0.1%	–	0.05%	Reduced 1993
UK	0.5%	–	–	–	Present
Venezuela	0.5% [1%]	–	–	–	Reduced May 2000
Zimbabwe	0.45% V	–	–	–	Present

V = VAT on trade costs. Note that superscripts are explained in the 'detail' column
Source: Spratt (2006). See also Pollin (2005) and Darvas and von Weizsäcker (2010)

The implication of this for the implementation of an FTT, is that it would be necessary to mandate the central processors (such as SWIFT and other messaging systems) to either pass on the full information for foreign exchange transactions to the central bank, or to apply the tax themselves. Alternatively, Basle III could more explicitly say that forex transactions that do not go through centralised settlements systems with certain characteristics would require higher capital requirements. Similarly, central banks could require all forex transactions to go through certain types of settlements systems.

Notwithstanding these technical difficulties, the existing literature appears to support the idea that it is technically feasible to implement an FTT. Indeed, a report by the International Monetary Fund on the implementation of a global bank tax (IMF 2010), which argues against the implementation of an FTT,[33] nonetheless explicitly acknowledges that it would now be technically feasible to implement such a tax.

3.5 Do all countries have to act together?

Almost all recent policy announcements argue that any global system of taxation (whether a bank tax, an FTT or anything else) would have to be implemented by all countries (see, for example, IMF 2010; UK HM Treasury 2009).[34] Again the underlying rationale is that were a country not to participate it might be possible

33 The IMF's rejection of an FTT is on the grounds that it does not help to address systemic risk, which was the remit that it was given by the G-20.

34 See Eggert and Kolmar (2004) for a theoretical treatment and a taxonomy of alternative systems of international capital income taxation.

for payments to be routed through that country in order to avoid the tax. However, the recent literature outlined above suggests that, contrary to popular belief, it might be possible for a single country to act alone. Spratt (2005, 2006), for example, suggests that a Tobin-like tax of 0.005 per cent could be unilaterally levied either in the UK sterling market or the euro market without significant problems of evasion and avoidance, due to the concentration of national and international payment and settlement systems such as CLS, CHAPS (Clearing House Automated Payment System, UK) and TARGET. Similarly Schmidt (2008) suggests that it would be relatively straightforward to apply a currency transaction tax (also of 0.5 basis points) to only the US dollar, euro, UK pound and yen.

Spratt's analysis is strongly disputed by representatives of the financial sector. The London Investment Banking Association,[35] in their response to the report of the All Party Parliamentary Group on Debt, Aid and Trade (Thornton 2007), argued that unilateral imposition of the tax on sterling transactions could give rise to the migration of large sterling exchanges offshore, pointing out that the eurodollar market was created over 40 years ago in part because of the imposition of a US withholding tax (LIBA 2007). The disagreement hinges on their different interpretations of three factors discussed above: whether gross transactions can be identified (to prevent avoidance through the use of bilateral netting mechanisms); whether substantively all transactions can be mandated to use settlement mechanisms under the control of the relevant tax authorities (to prevent the emergence of offshore settlement centres); and whether the tax can be applied to a sufficiently broad range of instruments to prevent the use of derivatives or synthetic products which provide an economic result equivalent to an actual purchase or sale of currency while avoiding actual cash delivery.

Baker (2000) also argues that it would be possible to impose a similar tax unilaterally in the US market. He recognises that unilateral action is not the best outcome, since it opens up the possibility of evasion. Moreover, he argues that a tax levied only on the US markets will have very little impact on the dynamics of global markets and that the revenue collected would be commensurately smaller if other countries did not participate. However, akin to some of the two-market theoretical models described above, he argues that implementation of such a tax by the US would induce a shift in the political dynamics of the relevant interests groups because financial actors in the taxed regions will pressure their governments to press other countries to implement the tax.

Notwithstanding these views, the general consensus in the literature is that, for currency transaction taxes, an international (or at least plurilateral) agreement would be preferable to unilateral action. This is in marked contrast to transaction taxes on equities and some other securities which have already been implemented unilaterally by a large number of countries – see Table 3.1.

35 Now the Association for Financial Markets in Europe.

4 How much money would a financial transaction tax collect?

Although this was not Tobin's original intention, one of the principle motivations of those proposing the tax is to raise substantial revenue. A huge number of different revenue estimates have been calculated in the literature leading to considerable confusion as to the likely revenue from the implementation of such a tax. The reason for these differences is the different assumptions which are made by authors regarding the base of the tax, the tax rate and the extent to which the volume of trade would be reduced by the introduction of the tax. In order to try to estimate how much money a Tobin tax would collect, we have compiled all of the papers that we have been able to find that provide a detailed calculation of the revenue from a Tobin or Tobin-like tax. The findings are summarised in Table 4.1 for literature providing estimates which assume worldwide application of the tax, and in Table 4.2 for estimates of revenue from the application of the tax to single markets or groupings of countries.

Perhaps the most striking characteristic of Table 4.1 and Table 4.2 is the huge range of revenue estimates, from US$10 billion per year from Kapoor (2004) to US$376 billion per year from Tax Research LLP (2010). In part, the differences reflect the huge growth in the foreign exchange market since the early 1990s and the resulting large differences in the base of the tax. Kapoor, using data from 2001 has a daily tax base of spot, outright forwards and swaps of US$1,200 billion – Schmidt (2008) uses exactly the same tax base, but in 2007 this had risen to US$3,227 billion. Moreover, there are also different views about the composition of the base. Whilst most studies include spot, outright forward and swaps in their base, some also include futures and options; the large estimate from Tax Research LLP (2010) reflects their inclusion of the bond and equity markets as well as forex.

Far larger variation, however, can be found in the choice of tax rates to impose. These vary from 0.25 per cent proposed by D'Orville and Najman (1995) and even 1 per cent at the top end of the range estimated by the Belgian and Finnish Ministries of Finance (Belgium, Ministry of Finance 2001; Finland, Ministry of Finance 2001), to the more common 0.005 per cent proposed by Schmidt (2008), Kapoor (2004) and the Tax Research LLP (2010). Over time there has been a tendency for proposed tax rates to fall as transaction costs have also been reduced.

Revenue estimates from the unilateral or regional application of a Tobin tax are commensurately smaller given the smaller tax base. Most work has been done on the application of the tax in the EU (Belgium Ministry of Finance 2001; Spahn 2002; Jetin and Denys 2005; Schulmeister, Schratzenstaller and Picek 2008). However, calculations have also been done for the large individual currencies (Spratt 2005; Schmidt 2008) as well as for individual countries such as France (France Ministry of the Economy, Finance and Industry 2000) and the USA (Baker *et al.* 2009). Again the range of estimates is wide, depending primarily on the tax rates assumed, although there is a tendency in these studies to assume small tax rates of around 0.01 per cent or 0.02 per cent.

Table 4.1 Estimated revenues from worldwide application of a Tobin tax

Author(s)	Year tax base	Geographical coverage	Tax base (US$ bn) per day	Base description		Trading days per annum	Tax rate
D'Orville and Najman (1995)	1992	Worldwide	293	Forex	Spot, outright forward, swaps, futures and options	240	0.25%
D'Orville and Najman (1995)	1992	Worldwide	293	Forex	Spot, outright forward, swaps, futures and options	240	0.10%
Spahn (1995)	1995	Worldwide	1000	Forex	All spot and derivatives	250	0.02%
Felix and Sau (1996)	1992	Worldwide	576	Forex	Spot, outright forward, swaps, futures and options	250	0.25%
Kenen (1996)	1992	Worldwide	880	Forex	Spot, outright forward, swaps, futures and options	240	0.05%
Frankel (1996)	1995	Worldwide	1230	Forex	Spot, outright forward, swaps	240	0.10%
France, Ministry of the Economy, Finance and Industry (2000)	1998	Worldwide	1500	Forex	Spot, outright forward, swaps		0.01–0.2%
Belgium, Ministry of Finance (2001)	1998	Worldwide	1500	Forex	Spot, outright forward, swaps	250	0.01–1%
Finland, Ministry of Finance (2001)	1998	Worldwide	1442	Forex	Spot, outright forward, swaps	240	0.01 0.25% 1%
Binger (2003)	2001	Worldwide	1200	Forex	Spot, outright forward, swaps		0.1%
Nissanke (2004)	2001	Worldwide	1173	Forex	Spot, outright forward, swaps		0.01–0,02%
Kapoor (2004)	2001	Worldwide	1200	Forex	Spot, outright forward, swaps		0.005%
Jetin and Denys (2005)	2004	Worldwide	1900	Forex	Spot, outright forward, swaps	250	0.1% (preferred scenario)
	2004	Worldwide	1900	Forex	Spot, outright forward, swaps	250	0.02% (intermediate scenario)
	2004	Worldwide	1900	Forex	Spot, outright forward, swaps	250	0.01–0.02% (minimal scenario)

Exempted official trading	Fiscal evasion	Pre-tax transaction costs	Elasticity	Reduction of volume	Total annual revenue (US$ bn)
				20%	**140.1**
				20%	**56.32**
				none	**50**
10%.	25%	0.5%	0.75		**205.5**
					100
20%		0.1%	0.32	20%	**166**
	20%	0.02–0.05%	0.5 (non-financial sector) 1 (other financial institutions) 1.5 (interbanking sector)	67% (central estimate)	**50 (EUR bn central estimate)**
from 15% (if tax 0.01%) to 25% (if tax 1%)		0.1% (non-financial sector) 0.05% (other financial institutions) 0.02% (interbanking sector)	0.5 (non-financial sector) 1 (other financial institutions) 1.5 (interbanking sector)	4.7–99.7%	**19–128**
		0.1% (non-financial sector) 0.05% (other financial institutions), 0.02% (interbanking sector)	0.5 (non-financial customers) 1 (financial customers) 1.5 (banks)		**71** **102** **177**
				50%	**132**
8%	2%	0.01–0.02%	0.12–0.23	5% (0.01% tax rate) 15% (0.02% tax rate)	**17–31 (uniform rate at 0.01–0.02%)** **19–35 (non-uniform rate at 0.01– 0.02%)**
				none	**10** **15**
	16%	0.10%	1	67%	**125**
	15.2%	0.02%	1	67%	**25**
	15.1% (0.01% tax rate) to 15.2% (0.02% tax rate)	0.02%	0.5	29% (if tax rate 0.01%) 42% (if tax rate 0.02%)	**27**

Table 4.1 Estimated revenues from worldwide application of a Tobin tax (cont.)

Author(s)	Year tax base	Geographical coverage	Tax base (US$ bn) per day	Base description		Trading days per annum	Tax rate
Jetin and Denys (2005) (cont.) *Alternative formula (following Belgium, Ministry of Finance (2001) and Finland, Ministry of Finance (2001)*	2004	Worldwide	1,900	Forex	Spot, outright forward, swaps	250	from 0.01% to 1%
Schulmeister *et al.* (2008)	2006	Worldwide	3,637	Forex	All spot and derivatives (exchange and OTC)	250	0.01% 0.05% 0.1%
Schmidt (2008)	2007	Worldwide (major currencies)	3,227	Forex	Spot, outright forward, swaps	240	0.005%
Tax Research LLP (2010)	2007–08	Worldwide	16,440	All markets	All spot and derivatives (exchange and OTC)	250	0.5% (equity) 0.005% (others)

Source: Authors' compilation from cited sources

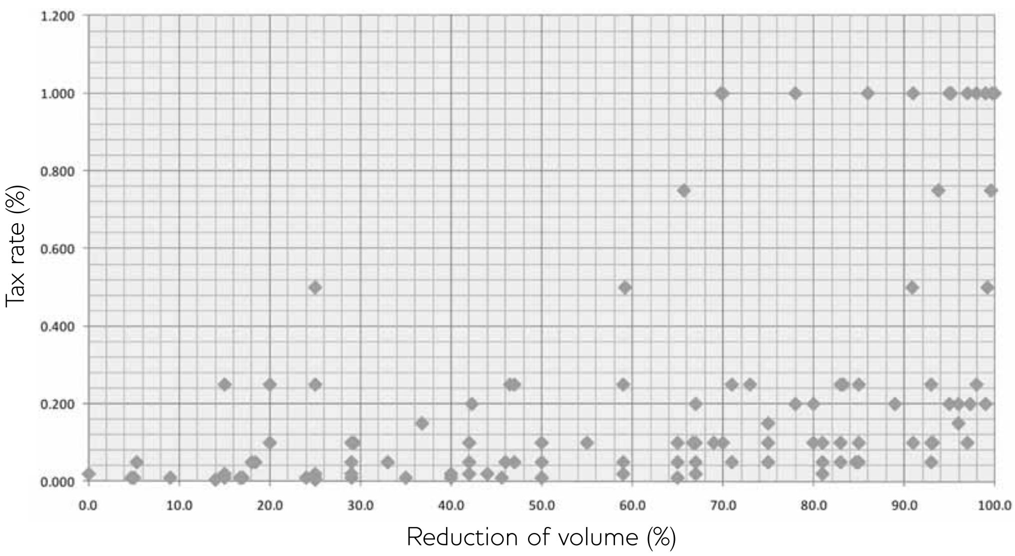
There has been a wide range of attempts to take into account the likely reduction in trade volume as a result of the imposition of the tax. This takes two forms. Several studies (Felix and Sau 1996; Frankel 1996; France, Ministry of the Economy, Finance and Industry 2000; Belgium, Ministry of Finance 2001; Nissanke 2004; Jetin and Denys 2005) either provide exemptions from the tax for some groups, or assume a degree of evasion of the tax, typically between 15 and 25 per cent. More commonly, studies tend to assume a reduction in volume or an elasticity of volume with respect to transaction costs (although with some notable exceptions, e.g. Spahn 1995; Kenen 1996; Kapoor 2004). The lower the elasticity, the higher the amount of revenue which the tax can collect (Palley 1999).The size of the assumed reduction is often chosen arbitrarily, and the values therefore vary enormously – in one study from 4.7 per cent to 99.7 per cent (Belgium, Ministry of Finance 2001). Similarly estimates of elasticities range from 0.12 (Nissanke 2004) to 1.5 (France, Ministry of the Economy, Finance and Industry 2000), with a mean of 0.535.

Given the bewildering range of estimates it is useful to try to abstract away from the issue of the tax base and focus on the assumptions about the tax rate and the extent of reduction in trade resulting from the tax. Figure 4.1 plots the assumptions about the tax rate and the amount of reduction for all of the studies of the worldwide market.

A clear pattern emerges from Figure 4.1. First, most studies assume tax rates of under 0.2 per cent, with many assuming a tax rate of 0.1 per cent or much less. Second, there is a huge range of assumptions about the likely reduction in volume, ranging from the negligible to almost total elimination of the market. There is a slight tendency for higher tax rates to be associated with larger reductions in volume, but for the most part Figure 4.1 reveals the uncertainty of the studies about the extent of reduction that would take place for any given tax rate.

Exempted official trading	Fiscal evasion	Pre-tax transaction costs	Elasticity	Reduction of volume	Total annual revenue (US$ bn)
	15.1% (0.01% tax rate) to 25% (1% tax rate)	0.1% (non-financial sector) 0.05% (other financial institutions) 0.02% (interbanking sector)	0.5 (non-financial sector) 1 (other financial institutions) 1.5 (interbanking sector)	4.7–99.7%	**27.8 (0.01% tax rate) 210.5 (1% tax rate)**
				15–35%; 50–75%; 65–85% (according to the tax rate)	**51 to 68 63 to 169 85 to 253 (according to the tax rate)**
				14%	**33.41**
				25%	**376**

Figure 4.1 Tax rates and volume reduction assumptions



Source: Authors' own

4.1 Empirical estimates of transaction costs

Calculating the impact of a tax increase on the volume of trade requires some assessment of the size of the initial transaction costs in order to know what percentage increase in transaction costs would be caused by the tax. Again, studies assume a very wide range of values for transaction costs, from 1.25 per cent of the value of the transaction (Felix and Sau 1996) to 0.01 per cent (Nissanke 2004), although more recent studies tend to employ values at the lower end of this scale.

Table 4.2 Estimated revenues from unilateral and regional application of a Tobin tax

Author(s)	Year tax base	Geographical	Tax base (US$ bn) per day	Base description		Trading days per annum	Tax rate
France, Ministry of the Economy, Finance and Industry (2000)	1998	France	36 (EUR bn)	Forex	Spot, outright forward, swaps	250	0.01–0.2%
	1998	EU 15	525 (EUR bn)	Forex	Spot, outright forward, swaps	250	0.01–0.2%
Belgium, Ministry of Finance (2001)	1998	EU 15	772.5	Forex	Spot, outright forward, swaps	250	0.01–1%
Spahn (2002)	2001	EU and Switzerland (including UK)	367.6	Forex (Euro leg)	Spot, outright forward, swaps	250	0.01–0.02%
Jetin and Denys (2005)	2004	EU	659	Forex	Spot, outright forward, swaps	250	0.1% (preferred scenario)
	2004	EU	659	Forex	Spot, outright forward, swaps	250	0.02% (intermediate scenario)
	2004	EU	659	Forex	Spot, outright forward, swaps	250	0.01–0.02% (minimal scenario)
Alternative formula (following Belgium, Ministry of Finance (2001) and Finland, Ministry of Finance (2001)	2004	EU	659	Forex	Spot, outright forward, swaps	250	0.01–1%
Spratt (2005)	2004	EU leg	348	Forex	All Spot and derivatives (exchange and OTC)	260	0.005%
Spratt (2005)	2004	Sterling leg	160	Forex	All Spot and derivatives (exchange and OTC)	260	0.005%
Schulmeister *et al.* (2008)	2006	EU	2060	Forex	All Spot and derivatives (exchange and OTC)	250	0.01% 0.05 0.1%
Schmidt (2008)	2007	Dollar	2,770	Forex	Spot, outright forward, swaps	240	0.005%
	2007	Euro	1,188	Forex	Spot, outright forward, swaps	240	0.005%
	2007	Sterling and yen	2,055	Forex	Spot, outright forward, swaps	240	0.005%

Exempted official trading	Fiscal evasion	Pre-tax transaction costs	Elasticity	Reduction of volume	Total annual revenue (US$ bn)
		0.02 and 0.05%	0.5; 1; 1.5	67%	**2** (EUR bn central estimate)
		0.02 and 0.05%	0.5; 1; 1.6	67%	**22** (EUR bn central estimate)
from 20.2% (if tax 0.01%) to 35% (if tax 1%)		0.1% (non-financial sector) 0.05% (other financial institutions) 0.02% (interbanking sector)	0.55 (non-financial sector) 1.1 (other financial institutions) 1.75 (interbanking sector)	5.1–99.9%	**9** (0,01% tax rate) **39** (1% tax rate)
					9.193 (uniform 0.01%) **14.585** (non uniform 0.02%)
	16%	0.10%	1	67%	**38**
	15.2%	0.02%	1	67%	**8**
	15.1% (0.01% to 15.2% (0.02% tax rate)	0.02%	0.5	29% (if tax rate 0.01%) 42% (if tax rate 0.02%)	**8** (if tax rate 0.01%) **13** (if tax rate 0.02%) tax rate)
	15.1% (0.01% tax rate) to 25% (1% tax rate)	0.1% (non-financial sector) 0.05% (other financial institutions) 0.02% (interbanking sector)	0.5 (non-financial sector) 1 (other financial institutions) 1.5 (interbanking sector)	4.7–99.7%	**8.4** (if tax rate 0.01%) **55.3** (if tax rate 1%)
				2.50%	**4.4**
				2.50%	**2.07**
				15 to 35% 50 to 75% 65 to 85% (according to the tax rate)	**29–38** **36–95** **48–143**
				14%	**28.38**
				14%	**12.29**
				14%	**21.24**

Table 4.2 Estimated revenues from unilateral and regional application of a Tobin tax (cont.)

Author(s)	Year tax base	Geographical	Tax base (US$ bn) per day	Base description		Trading days per annum	Tax rate
Schmidt (2008) (cont.)	2007	Yen	530	Forex	Spot, outright forward, swaps	240	0.005%
	2007	Sterling	462	Forex	Spot, outright forward, swaps	240	0.005%
Baker *et al.* (2009)	2008	USA	2604.407	All the markets	Spot, outright forward, swaps		0.5% (equity, options) 0.02% (bonds, futures and forwards) 0.01% (Forex, swaps)

Source: Authors' own

Surprisingly, very few studies take their assumed values for transaction costs and elasticities from empirical estimates of these figures. Table 4.3 shows the estimates of transaction costs in forex markets from several studies. Most studies use bid-ask spreads and triangular arbitrage to calculate transaction costs. Aliber *et al.* (2003) criticise these traditional approaches because they focus entirely on measuring the transaction costs faced by commercial customers of banks, ignoring the fact that 90–95 per cent of forex transactions occur between banks themselves. To avoid using bid-ask spread quotes, Aliber *et al.* draw on the prices of foreign currency futures, since future contracts are traded on a well-organised exchange with a well-defined price. They exploit deviations from interest parity type relationships to measure the transaction costs of the marginal investors (usually large commercial banks), which are likely to capture the minimum level of overall transaction costs. Most recently Darvas (2009) has used data from leveraged carry trade portfolios to calculate transaction costs for currency pairs. Although the range of different methodologies, time periods and institutions clearly give rise to different estimates, it is interesting to note that the median estimate is in line with the range quoted by the London Investment Bankers Association in 2007 (LIBA 2007).

Empirical estimates of transaction costs in other markets also exist. Table 4.4 shows the transaction costs reported by Pollin *et al.* (2003) for equity, futures, OTC and bond markets. Pollin *et al.* (2003) report three different estimates of equity transaction costs. The first set of estimates, expressed as percentage of trade value, is from Stoll (1993), who estimates 'trading costs in the large', i.e. costs derived from aggregate revenues of securities firms, as opposed to 'trading costs in the small' where one tries to examine the impact of individual trades. The second is taken from the work of Keim and Madhavan (1998), who develop one version of a 'trading costs in the small' transaction cost estimate, for both the exchanges and NASDAQ. These measure both 'implicit' and 'explicit' trade costs for institutional equity trades, on a per trade basis. The main explicit trade cost is the commission paid to the broker for execution. The implicit trading costs include bid-ask spreads, the price impacts of large trades on markets, and the opportunity costs associated with missed trading opportunities.

The third set of estimates is by Reiss and Werner (1996) who develop a new measure of transaction costs, the 'adjusted apparent spread', which enables them

Exempted official trading	Fiscal evasion	Pre-tax transaction costs	Elasticity	Reduction of volume	Total annual revenue (US$ bn)
				14%	**5.59**
				14%	**4.98**
				0% 25% 50%	**353.8** **265.3** **176.9** (according to the volume reduction)

to track discounting patterns on larger trades relative to the touch spread on smaller trades. Using data from the London Stock Exchange Automated Quotation system, SEAQ, the UK equivalent to NASDAQ, they define the apparent spread as the difference between the transaction price and the quoted ask. This provides an upper bound on transaction costs because SEAQ's best execution would guarantee a reverse purchase execution at or within the ask.

For transaction costs in options, Diltz and Swidler (1993) estimated observed transaction costs for ten actively traded Chicago Board Options Exchange (CBOE) call options for the calendar year 1988. The analysis was restricted to the nearest-to-the-money calls to mitigate potential biases resulting from combining the near-to-the-money options with the distinct in- and out-of-the-money markets. Similarly, Locke and Venkatesh (1997) use data from six months of trading in 12 futures contracts on the Chicago Mercantile Exchange (CME) in 1992. They calculate a direct measure of per contract transaction costs equal to the difference between the average purchase price and the average sale price for all futures customers, with prices weighted by transaction size (see also Wang, Yau and Baptiste 1997; Wang and Yau 2000). Finally, transaction costs in the bond market have been estimated by Hong and Warga (2000) both for bonds traded at the NYSE Automated Bond System (ABS) and the OTC dealer market between March 1995 and February 1997.

Overall, the size of transaction costs clearly varies with the market (transaction costs for equity are higher than those for forex), the size-class of the trades (small trades cost more), whether the trades take place on an exchange or OTC (the latter are more expensive), and the time period during which the trade takes place (transaction costs have declined over time). Table 4.3 shows that the median transaction cost for foreign exchange markets is around 0.024 per cent of the transaction value. Transactions in futures markets are of a similar order of magnitude. By contrast, costs on equities (Table 4.4) can be over 1 per cent, even for some exchange-traded stock. These large differences are the reason that Pollin *et al.* (2003) suggest that the size of any FTT should be tailored to the size of the underlying transaction costs in each market to try to ensure a more uniform percentage increase in transaction costs from such a tax.

Table 4.3 Empirical estimates of transaction costs in the foreign exchange market

Author(s)	Currency	Year	Pre-tax transaction costs (% of the trade value)
Felix and Sau (1996)	Forex		0.925
Frankel (1996)	Forex		0.1
France, Ministry of the Economy, Finance and Industry (2000)	Forex		0.035
Belgium, Ministry of Finance (2001)	Forex		0.05
Finland, Ministry of Finance (2001)	Forex		0.05
Nissanke (2004)	Forex		0.015
Jetin and Denys (2005)	Forex		0.02
Aliber (2003) *using Roll's (1984) formula*	British pound	1988–1999	0.024
	Deutschemark	1988–1999	0.018
	Japanese yen	1988–1999	0.041
	Swiss franc	1988–1999	0.035
Aliber (2003)	British pound	1988–1999	0.023
	Deutschemark	1988–1999	0.021
	Japanese yen	1988–1999	0.019
	Swiss franc	1988–1999	0.023
Darvas (2009)	USD–GBP	1999–2008	0.048
	USD–DEM	1999–2008	0.053
	USD–JPY	1999–2008	0.080
	USD–CHF	1999–2008	0.070
	USD–CAD	1999–2008	0.065
	USD–AUD	1999–2008	0.120
	USD–NZD	1999–2008	0.159
	USD–DKK	1999–2008	0.099
	USD–SEK	1999–2008	0.117
	USD–NOK	1999–2008	0.098
Median estimation			0.024

Source: Authors' own

Table 4.4 Empirical estimates of transaction costs in other markets

Description				Pre-tax transaction costs (% of trade value)	Median values
US equity market	Average one-sided costs (Stoll 1993)	Exchanges	1980	**0.689**	**0.487**
			1990	**0.285**	
	One-sided costs on buyer-initiated institutional trades (Keim and Madhavan 1998)	Exchanges – by size of firm	1998	**1.78–0.31**	**1.045**
		– by size of trade		**0.31–0.90**	**0.605**
		NASDAQ – by size of firm	1998	**2.85–0.24**	**1.545**
		– by size of trade		**0.76–1.80**	**1.28**
UK SEAQ market	Median one-sided 'Adjusted Apparent Spread' (Reiss and Werner 1996)	FTSE-100 size class	1996	**0.71**	**0.71**
		Medium-sized class		**1.31**	**1.31**
		Smaller-Size class		**2.28**	**2.28**
	Median estimation (equity)				**1.1625**
Options	Mean transaction costs for ten actively traded firms (Diltz and Swidler 1993)	Shorter-term options	1988	**4.9–21.3** (% of call option premium)	**14.6 (mean)**
		Longer-term options		**3.1–12.7** (% of call option premium)	**8.2 (mean)**
Futures	12 futures contracts on the CME (average TC: low–high estimates) (Locke and Venkatesh 1997)	CME	1992 (6 months)	**0.0184–0.0589**	**0.03865**
OTC	US equity market (Stoll 1993)		1980	**1.528**	**1.528**
			1990	**0.761**	**0.761**
Bond	(Hong and Warga 2000)	NYSE and dealer market transactions	1995–97	**0.13–0.2**	**0.165**

Source: Authors' compilation from cited sources

4.2 Empirical estimates of elasticities

The literature also has some estimates of the elasticity of the volume of trade in the foreign exchange market with respect to transaction costs. A recent study by Bismans and Damette (2008) estimates this elasticity using individual time series data, as well as with a seemingly unrelated regressions estimation (SURE) framework to account for the possibility of a relationship between exchange parities because traders react the same way to news for different currency pairs.

Table 4.5 Empirical estimates of elasticity of forex volume with respect to transaction costs

Method	Period	Currencies	Elasticity (-)
Time series analysis: single series separately	24/11/04 to 25/11/04	EUR–USD	**0.61**
	24/11/04 to 25/11/04	GBP–USD	**0.55**
	24/11/04 to 25/11/04	CAD–USD	**0.3**
	24/11/04 to 25/11/04	JPY–USD	**0.79**
Time series analysis: system of four equations (SURE)	24/11/04 to 25/11/04	EUR–USD	**0.33**
	24/11/04 to 25/11/04	GBP–USD	**0.36**
	24/11/04 to 25/11/04	CAD–USD	**0.23**
	24/11/04 to 25/11/04	JPY–USD	**0.008**
Panel: fixed effect	24/11/04 to 25/11/04	EUR–USD GBP–USD CAD–USD JPY–USD	**0.606**

Source: Bismans and Damette (2008)

In addition, they estimate an overall elasticity using a fixed-effect panel approach (Table 4.5). Individual time series estimates are higher (mean 0.56) than SURE estimates (mean 0.23), whilst the panel estimate is of the same order of magnitude as the individual time series estimates. It is notable that these estimates are substantially lower than some of the elasticities used in the revenue estimates reported in Table 4.1 and Table 4.2.

A number of studies have also calculated volume elasticities for transaction costs in the equity market (Table 4.6). These show relatively small short-run elasticities of around 0.58. However Jackson and O'Donnell (1985) and Lindgren and Westland (1990) calculate long-run elasticities over 1.

4.3 A meta-estimate of revenue from a financial transaction tax

Rather than producing yet another estimate of the revenue from the Tobin tax, we attempt to provide a central estimate adopting the best practice from all the existing studies. We draw on the latest data on the size of each of the financial markets (including equity, derivative, forex and OTC markets) and assume 250 trading days.[36] We calculate the median of the available empirical estimates of the size of the transaction costs in each market. In keeping with the consensus in the literature that the tax should be small (Darvas and von Weizsäcker 2010), we adjust the tax rate so that it represents either a 10 per cent, 20 per cent, or 50 per cent increase in the transaction costs of trading in that market. Having no

36 The average across all financial markets is 248, but larger markets tend to have more trading days, so for simplicity we assume 250.

Table 4.6 Empirical estimates of elasticity of equity volume with respect to transaction costs

Author(s)		Market	Elasticity	Median Values
Schwert and Seguin (1993)	US security market		0.25–1.35	**0.8**
Baltagi, Li and Li (2006)	Equity	Chinese stock exchanges	1.0	**1.0**
Zhang (2001)	Equity	Shanghai stock exchange market	0.58	**0.58**
Zhang (2001)	Equity	Shenzhen stock exchange market	0.49	**0.49**
Jackson and O'Donnell (1985)	Equity	UK	0.9–1.65	**1.275**
Lindgren and Westland (1990)	Equity	Sweden (1970–88)	0.85–1.35	**1.1**
		Median		**0.8**
	Median estimations (without long run)			**0.58**

Source: Authors' own

evidence on the extent of fiscal evasion, we use 20 per cent, which is the median figure used in other simulations. Similarly, we use the median elasticity of volume with respect to transaction costs in each market found from empirical studies.[37] To calculate the revenue we use a modified version of the formula from Jetin and Denys (2005).[38]

$$R = 250 \times \tau \times V \times (1 - ev) \times \left(1 + \frac{\tau}{k}\right)^{\varepsilon}$$

where R is the annual revenue, 250 is the number of business days per year, τ is the tax rate, V is the market turnover before tax, ev is fiscal evasion, k is the pre-tax transaction costs, and ε is the volume elasticity. The results are shown in Table 4.7.

We find that using empirically derived estimates of transaction costs and elasticities gives larger estimates of revenue than many previous studies, suggesting that previous simulations have been overly cautious in constructing their revenue estimates. Applying a 0.005 per cent tax to the foreign exchange market alone might raise around US$25 billion per year worldwide. Including the other markets, the tax of 10 per cent of existing transaction costs could raise almost US$150 billion, even if the OTC market is excluded, and almost US$500 billion if it is included. Of course

37 Since we have no empirical estimates of the transaction cost elasticity of volume for the OTC markets, we assume that these are the median of the largest values from the empirical studies of equity markets.

38 Jetin and Denys (2005) use a two-sided tax because they focus on the forex market. We tax each transaction only once.

Table 4.7 Meta estimate of worldwide revenue from the imposition of FTTs

Market	World ($ bn)	UK ($ bn)	Business days (average)	Tax rate %	Transaction cost (pre-tax average) %	Fiscal evasion (average) %	Elasticity of volume (average)	Total annual revenues world ($ bn)	Total annual revenues UK ($ bn)
Equity market	456	18	250	*0.116*	1.163	20	0.58	100	4.0
	456	18	250	*0.233*	1.163	20	0.58	191	7.6
	456	18	250	*0.581*	1.163	20	0.58	419	16.8
Derivative	4,933	1,335	250	*0.004*	0.039	20	1.5	33	8.9
	4,933	1,335	250	*0.008*	0.039	20	1.5	58	15.7
	4,933	1,335	250	*0.019*	0.039	20	1.5	104	28.1
Forex	2,914	1,269	250	*0.002*	0.024	20	0.606	13	5.7
	2,914	1,269	250	*0.005*	0.024	20	0.606	25	10.9
	2,914	1,269	250	*0.012*	0.024	20	0.606	55	23.8
OTC	2,544	1,094	250	*0.076*	0.761	20	1.5	336	144.3
	2,544	1,094	250	*0.152*	0.761	20	1.5	589	253.3
	2,544	1,094	250	*0.381*	0.761	20	1.5	1,054	453.1
				Total	**Without OTC**	Tax rate 10% TC		**147**	**18.7**
						Tax rate 20% TC		**274**	**34.2**
						Tax rate 50% TC		**577**	**68.7**
					With OTC	Tax rate 10% TC		**482**	**163.0**
						Tax rate 20% TC		**863**	**287.6**
						Tax rate 50% TC		**1631**	**521.8**

Source: Authors' calculation based on data reported by IFSL and BIS.

we cannot be sure that a real tax would raise this sort of revenue. The key weakness is that we have no empirical estimate of fiscal evasion – if evasion were to be 80 per cent rather than 20 per cent, clearly the figures would be much smaller. At the same time, the empirical estimates that we have for transaction costs and elasticities suggest that, even if the tax were restricted to a single market, such as the foreign exchange market, large sums of revenue might be raised. Moreover, the revenue potential for the UK is also significant – around $10 billion (£7.5 billion) from a 0.005 per cent tax applied only to the foreign exchange market.[39]

Like all revenue estimates in this area, these results should be treated with considerable caution. First, if a transaction tax were implemented, then, unless all gross transactions were captured, its imposition would be likely to cause a huge amount of netting, which might substantially reduce the tax take. More generally, using backward-looking data to simulate the impact of a tax that might change the structure of markets is a highly uncertain process, even with the best available data on transaction costs and elasticities.

Second, we have focused on calculating the revenue potential of an FTT. It is beyond the scope of this review to compare the relative efficiency of an FTT with other forms of financial sector taxation (see IMF (2010) for a discussion on this; Honohan (2003) provides a comprehensive treatment), so we make no claims about whether an FTT is the best way of raising such funds. These caveats notwithstanding, the existing evidence does appear to support the view that an FTT representing a modest proportionate increase in existing levels of transaction costs could yield quite large sums of revenue.

5 What would be the incidence of the Tobin tax?

One of the most prominent claims made by proponents of a Tobin tax is that the incidence of the tax would be extremely progressive, primarily affecting wealthy institutions and individuals (Tax Research LLP 2010; Kapoor 2010). However, such analyses make the common error of confusing who would actually pay the tax with the issue of where the incidence of tax would lie. By the same token, opponents of the tax have been quick to argue that the incidence would fall entirely on end users, but generally provide no basis for this claim.

Unfortunately, actual evidence on the incidence of a Tobin tax is extremely sparse. The few studies that have mentioned the issue have tended to guess the likely incidence based upon the design of the tax. For example, the Landau report[40]

39 This assumes that the tax is applied to all forex transactions occurring in the UK. Clearly this revenue would only be achieved if other major markets also applied the tax. See Table 4.2 for estimates when the tax is applied only to sterling transactions.

40 This report was commissioned by President Chirac to explore alternative sources of finance for development. It consisted of a distinguished group of economists led by Jean Paul Landau, former director for France at the European Bank for Reconstruction and Development (EBRD) and minister councillor in charge of financial affairs at the French Embassy in London.

(Landau *et al.* 2004) argues that the economic impact of a Tobin tax in the forex market is uncertain. However, it claims that its incidence

> would probably fall entirely on end-customers, i.e. corporations with international operations and fund and asset managers engaged in reallocating portfolios internationally including hedge funds, which can occasionally play an important role in foreign exchange markets. The tax may be seen as an indirect means of reaching an elastic and highly mobile base; it would also penalize international portfolio diversification, with little economic justification. It would furthermore penalize those countries with very open markets, whose volume of foreign exchange transactions relative to GNP is fairly high.
> (Landau *et al.* 2004: 59)

However, the report presents no evidence or argument to support the view that the incidence would fall entirely on end customers. A report by UK HM Treasury (2009) shares the same concern, stating that ‘it needs to be clearly ascertained that the incidence of the tax will not in practice fall on end users of financial services within the economy at large’ – but again, no evidence is put forward about what the likely incidence might actually be or why.

Even if such a tax increased costs for end users, it is not necessarily the case that increased taxation of an intermediate good, such as financial transactions, lowers welfare. Higher individual trading costs will lower trading volume; if the elasticity of trade volume with respect to trading costs is high, a tax could reduce aggregate trading costs. The overall welfare effect therefore critically depends on the value that one places on the trades forgone. If a reduction in trading volume worsens overall economic performance, then an FTT might have a significant negative impact, but we are unaware of evidence that shows a causal link between the volume of trade and overall economic performance.[41]

Spahn (2002) analyses the incidence of a ‘politically feasible Tobin tax’ (PFTT) in the foreign exchange markets. He states that the effects of the PFTT would have three effects:

1. An increase of bid-ask spread.
2. A reduction of the trading volume.
3. An increase in length of the average maturity of foreign exchange transactions, because of the strong decline of spot transactions relative to outright forwards.

He argues that the initial incidence will be on wholesalers,

> as a consequence of technological developments, although they remain in fierce competition among each other at a global scale, and they rely on high transactions volumes to remain profitable in view of minute profit margins, despite of *[sic]* cost decreases.
> (Spahn 2002: 52)

41 Conversely, it is not necessarily the case that such a tax would harm speculators. Dow and Rahi (2000) show that speculators could gain from such a tax if their benefit from less informative prices offsets the costs of the tax. The effect on the welfare of other agents depends on how revelation of information changes risk-sharing opportunities in the market.

Moreover, Spahn suggests that wholesalers would try to shift the tax burden onto final consumers to maintain profitability: ‘Since final customers have only 13.3 per cent of the market,[42] a tax of one basis point would quickly be transformed into 7.5 basis points onto the final customer’ (Spahn 2002).

However, he argues that it is not clear to what extent it will be possible for the tax to be shifted to the end consumer. It will be easiest to do this in retail trading because demand is relatively price-inelastic and locally limited, which allows a degree of monopoly rents. Similarly it should be easier to pass on costs to small and medium-sized companies than to multinational firms. The latter have much more influence on foreign exchange traders given their higher trading volumes. Indeed, some multinational firms can run their own foreign exchange departments, which would intensify competition.

Institutional portfolio investors and insurance companies tend to have a longer-term perspective. Their behaviour is driven by institutional rules and their volume of trade is smaller than their stock of assets. As a result they are in a stronger position to take on the tax burden and shift it to their consumers over a long period of time. Investment funds, on the other hand, tend to concentrate on securities that are short-term market favourites and change their portfolio frequently. Spahn argues that

> If the change of securities denominated in different currencies is more costly through the tax than trading securities of one single currency, portfolio investors will focus on the latter and avoid foreign exchange trading as far as possible. It implies that shifting the tax burden onto this group of market participants is more difficult than for longer-term investors such as insurance companies.
> (Spahn 2002: 56)

Furthermore, tax avoidance, by focusing on the trade of securities in a single currency, will be easier for funds specialising in the securities of industrialised countries than for those specialising in the securities of developing and emerging economies, because the former can easily change their strategies due to more liquid and deep markets within the respective currency areas that do not necessitate frequent changes in currency positions.

Hillman, Kapoor and Spratt (2006), on the other hand, argue that

> most transactions in the FX [foreign exchange] markets are conducted between banks themselves or with other large players in the financial services industry. Transactions with individuals (for overseas travel for example) constitute less than 0.1% of total transactions and trade-related transactions amount to less than 10%. A significant proportion of the tax burden is thus likely to be borne at least initially by the financial services industry itself with some of the costs being passed on to trade related transactions. The financial services industry is disproportionately used by the richer segments of the society so the tax incidence is likely to be socially progressive and is unlikely to affect the majority of the population in any tangible way.
> (Hillman *et al.* 2006: 12–13)

42 The rest is banks and other financial institutions.

They therefore argue that the ‘economic footprint’ of the tax would, in the first instance, fall upon these large financial institutions that are members of the CLS Bank and the RTGS systems.

Hillman *et al.* (2006) also provide a rough calculation of the likely incidence of the tax on the corporate sector as follows:

> CLS Bank settles only around half of all FX transactions, which suggests a global figure of 68,000 sterling trades per day. Over a year, therefore, we can estimate the total number of sterling transactions to be of the order of 17.7 million. The impact of the Currency Transaction Development Levy [CTDL] of 0.005 per cent would be spread very widely internationally with tens of thousands of participants carrying out the 17.7 million transactions. The cost would be in the region of $117 per trade, on an average trade size of a little over $2 million. For corporations, however, the situation is clearly different. For example, the UK exports somewhere in the region of $380 billion worth of goods and services per year. Based on the profit margins of UK companies from 1990 to 2002, we assume an average margin of 10 per cent. Ten per cent of $380 billion is $38 billion, which we take as a rough estimate of the annual profit of the UK’s export sector. The impact of the CTDL on UK corporates would be somewhere in the region of $115 million. Consequently, the impact on UK exporters would be just 0.3 per cent of their annual profits, which is very small when set against the many other factors that influence company profitability. For example, over the past ten years, UK companies’ average profitability has fluctuated by up to 10 per cent per year. It is therefore clearly the case that when compared to the impact of changes to general business conditions, and movements in indicators such as interest rates and the sterling exchange rate, a CTDL of 0.005 per cent will have hardly any discernable impact. This analysis is also applicable to the impact of the CTDL on the euro and the krone.
>
> Consequently, we estimate that at least half of the impact of the CTDL will eventually be passed on by banks to their global clients in the form of a slightly higher spread. The impact of the CTDL would therefore be dispersed widely throughout the global financial system, and not fall disproportionately on any single institution.
> (Hillman *et al.* 2006: 26–7)

The above papers all present arguments about the likely incidence of FTTs from first principles. To our knowledge, there are no empirical papers that attempt to calculate the incidence of Tobin-like taxes that have been applied in practice. However, there is a large literature on tax incidence in general, and several empirical studies of the incidence of particular taxes. Specifically, an FTT is a tax on transactions undertaken mainly by large corporations (banks), thereby reducing their profits; it therefore has some similarities with corporation income tax (CIT). We draw on the literature on the incidence of CIT to infer the likely incidence of a FTT.

The central difficulty in assessing the incidence of CIT is in tracing the incidence of a tax applied to a corporation to the individuals that ultimately bear the tax. One of the first studies, and a benchmark for much subsequent analysis, is by

Harberger (1962), who introduced a two-sector general equilibrium model of tax incidence. Two competitive industries, x and y, are assumed to employ two factors, capital (K) and labour (L) under conditions of constant returns to scale, and to pay them gross (i.e. tax-inclusive) returns equal to the value of their marginal products. Factors are assumed to be fixed in total supply and fully employed, with flexible prices and wages. In addition, Harberger assumed that: corporate tax can be viewed as an add-on tax on capital income originating in the corporate sector; production in a particular sector must be exclusively either corporate or non-corporate; there is free mobility of factors across sectors; it is a closed economy; there is no risk; and there are no differences in spending patterns among individuals and between individuals and government. Grouping all production in the US economy into two sectors according to whether production was predominantly carried out by corporate or non-corporate businesses, he then estimated incidence through the changes in factor prices and product prices that would result from a small increase in the corporate tax.

Harberger's main conclusion is that the burden of CIT is fully borne by the owners of capital, both in the corporate and non-corporate sectors. The intuition is that the lower after-tax return in the corporate sector because of the tax drives capital into the non-corporate sector, pushing down the non-corporate return. In equilibrium, the after-tax returns in the two sectors must be equal, and Harberger estimates that this new equilibrium level of after-tax returns will be lower by just the amount consistent with capital bearing the entire corporate tax. These findings suggest that the tax is progressive, since the owners of capital are usually among the better off in society.

However, Harberger's model also suggests that CIT is less progressive than previously believed since its incidence falls on all owners of capital and not just the shareholders of corporations. Prior to Harberger's work, it was generally believed that the burden of CIT fell on shareholders in proportion to their ownership (Auerbach 2005). Auerbach shows that in 2004 in the USA, households owned less than half of corporate equity, with the remainder held by various institutions and financial intermediaries including mutual funds, non-profit institutions and retirement funds. As a result, any increase in CIT is likely to have a much broader impact across society.

Both the shareholder paradigm of CIT incidence and Harberger's model are based on a static evaluation of the incidence of the tax. However, incidence has a dynamic dimension. Auerbach (2005) argues that, in the short run, shareholders may indeed bear most of the burden because of the lack of perfect mobility of both labour and capital between sectors. Thus, even if shareholders eventually shift the burden of CIT, there is likely to be a transition period during which they continue to bear a larger share of the burden. Thus Auerbach argues that the CIT will be borne partially by current capital owners of corporate capital, through an initial drop in asset values, and partially by future investors in corporate and non-corporate capital, through lower rate of returns.

Diamond and Mirrlees (1971), Harberger (1995), Randolph (2006), Gravelle and Smetters (2006) and Felix (2007) adapt Harberger's model to an open economy. Diamond and Mirrlees (1971) argue that, in a small open economy, capital taxes are inefficient because, in the end, labour bears the entire burden. The reason is that as soon as the economy becomes open, a tax on capital encourages capital to flee abroad until the point at which the after-tax return of capital equals the world return. In the domestic economy, this outflow of capital lowers the marginal product of labour and therefore decreases wages.

Harberger modified his model in 1995 to include open economy features. He measures the open economy incidence of the CIT by analysing a general equilibrium model of domestic and foreign economies, each with five sectors. The corporate sector that produces internationally tradeable goods is further subdivided into two subsectors. One of those subsectors produces goods that are perfect substitutes for the goods produced by the corresponding foreign sector. The second corporate subsector produces goods that are imperfect substitutes for goods produced by the corresponding foreign sector. When goods are produced in both corporate tradeable goods subsectors, the domestic and foreign wages are determined fully by the effects that the tax has on production costs within the first subsector. In the domestic economy, the CIT drives a wedge into the cost of production in the corporate sectors. Because the domestic economy cannot affect the world price of output in the first sector, the domestic wage must decrease in order to offset the increased corporate cost of capital. He finds that the burden of a CIT increase is fully shifted to labour, which may bear a burden 2 to 2.5 times bigger than the revenues generated by such an increase.

Randolph (2006) also uses a general equilibrium model to examine the long-run incidence of a CIT in an open economy. His model consists of two countries, which are identical except for size. For each economy, production is divided into five sectors. The first three sectors are corporate, the last two are non-corporate. Labour is homogeneous and perfectly mobile within each country, but cannot move between countries. Thus, the wage rate is the same for every sector within a country, but can differ between countries. Individuals do not vary their amount of labour supplied to the market. With this model he shows that domestic owners of capital can escape most of the CIT burden when capital is reallocated abroad in response to the tax.

However, capital owners worldwide do not escape the tax. Reallocation of capital abroad drives down the personal return to investment so that capital owners worldwide bear approximately the full burden of the domestic CIT. Foreign workers benefit because an increased foreign stock of capital raises their productivity and their wages. Domestic workers lose because their productivity falls and they cannot emigrate to take advantage of higher foreign wages. He argues that when capital is perfectly mobile and the tax does not affect the world prices of traded goods, domestic labour bears slightly more than 70 per cent of the long-run burden of the CIT. The domestic owners of capital bear slightly more than 30 per cent of the burden. Domestic landowners receive a small benefit. At the same time, the foreign owners of capital bear slightly more than 70 per cent of the burden, but their burden is exactly offset by the benefits received by foreign workers and landowners. When capital is less mobile internationally, domestic labour's burden is lower and domestic capital's burden is higher. Gravelle and Smetters (2006) similarly assume that capital is fixed and focus on product substitutability. They find that if the products are not perfect substitutes, labour bears less than 70 per cent of the tax burden. Its burden is also reduced by a low savings elasticity and the ability of the country to affect world prices.

Finally, Felix (2007) uses an empirical approach (panel regression with random effects) to measure the first order effect of openness on the incidence of CIT. He uses cross-country panel data from the Luxembourg Income Study, which covers 30 countries over five waves from 1979 to 2002. The results suggest that a 1 per cent increase in CIT results in a 0.5–0.7 per cent decrease in gross annual wages. Including an interaction term between openness and the CIT variables makes the negative effect on wages much higher: a 1 percentage point increase in the corporate tax rate lowers wages by 0.7–1.2 per cent. On average this means that an increase of CIT from 20 per cent to 21 per cent in 2000 in the USA would decrease total wages by US$43.5 billion, while the revenues would be US$10.4 billion. In other words, the marginal burden on labour would be 4.5 times the additional revenue generated by the CIT increase.

Felix also evaluated the incidence of a CIT increase on skilled versus non-skilled workers. Previous studies (e.g. Griliches 1969; Bergstrom and Panas 1992) proposed a *capital skill complementarity hypothesis*, suggesting that capital is more complementary to skilled labour than to unskilled labour. If this hypothesis holds, Felix argues that, in a small economy, one should expect the negative impact of CIT on wages to be greater for skilled than for unskilled workers. However, the empirical estimation does not lend support to this hypothesis. A 1 percentage point increase in CIT is estimated to decrease the wage of low-education labour by 0.91 per cent, middle-education labour by 0.72 per cent and high-education labour by 0.22 per cent. One possible explanation may be in the different degree of mobility between skilled and unskilled workers – if skilled workers are more mobile, they may be able to avoid the burden of the tax by moving abroad.

What can we draw from this discussion of CIT that may be relevant to the incidence of FTTs? There are several parallels. First, just as Auerbach (2005) argues for the CIT, it is clear that wholesale traders, particularly those involved in short-term foreign exchange transactions, would bear the initial cost of any FTT. At the same time, it seems likely that, in the long run, a significant proportion of the tax would end up being passed on to consumers in the form of lower returns or higher spreads. As Spahn (2002) points out, the final incidence will depend on the extent of competition in different segments of the financial sector. Nonetheless, as with CIT, it seems probable that the final incidence would be spread across all owners of capital (including home owners and those with mutual funds and pension funds). Even so, given that the distribution of capital in most countries is highly unequal so that most households earn relatively little of their income in the form of returns to capital, it would seem likely that a Tobin tax would be more progressive than several other forms of taxation (e.g. value added tax – VAT).[43]

This said, the evidence on the incidence of the CIT does suggest caution if, in practice, the imposition of the tax were to result in reduced unskilled wages in the long run. However, this effect would be reduced substantially if the tax were to be imposed by all the major financial centres, since this would reduce the incentives for capital outflows. Nonetheless, there is a clear need for further empirical research to ascertain the incidence of FTTs that have already been applied.

43 See Crawford, Keen and Smith (2010) on the incidence of VAT.

6 Summary and conclusions

To conclude, we return to the four questions which we set out at the beginning.

On the issue of volatility, the evidence is mixed. Theoretical models predominantly conclude that a Tobin tax would reduce volatility due to the changes it would induce in the composition of traders in the market. By reducing the share of noise traders or chartists, whose presence is usually assumed to be destabilising, a Tobin tax might enhance market stability. However, this conclusion is by no means guaranteed, with some models arguing that the tax would reduce informed traders by more than uninformed traders, thereby increasing volatility. Similarly, concerns are raised by the impact of the tax on market liquidity and the resulting effect on volatility, particularly if the tax substantially increases the existing level of transaction costs in a particular market.

Empirical work tends to confirm these fears with the balance of evidence suggesting that there is a positive relationship between transaction costs and volatility. Of course, it is not certain that the imposition of a tax would affect volatility in the same way as transaction costs, but the few studies that exist of actual financial transaction taxes do not provide much ground for optimism. We conclude that the Tobin tax, and other FTTs based on the value of the transaction, would probably fail in their original purpose of providing greater stability to the market. On the other hand, the evidence does not suggest that a Tobin tax would be highly destabilising either, at least not at the low rates of taxation typically proposed; volatility may increase, but only by a relatively small amount. Moreover, it is possible that alternative designs for the Tobin tax might have a more stabilising effect upon markets (see Spahn 1996; McCulloch 2010; Varela and McCulloch 2011).

On the second question of whether the Tobin tax and other FTTs are feasible, the literature points to a relatively clear conclusion. It is useful in answering this question to distinguish between securities transaction taxes on equity, bonds and related securities, and a Tobin tax on the foreign exchange markets. It is obvious that securities transaction taxes are feasible – Table 3.1 shows that they have been successfully implemented in several countries already, including the UK. The principles for the design of such taxes have been well elaborated in the literature (notably in Pollin *et al.* 2003; Summers and Summers 1989) and instruments to discourage avoidance are already available.

For the Tobin tax, the literature is less definitive. However, there is a clear sense that the significant shift towards centralisation in the foreign exchange market and the widespread use of common messaging and clearing systems means that a Tobin tax could be successfully implemented. Although implementation problems still remain, the literature does provide a reasonable consensus on how such a tax should be designed. There is a clear preference for coverage of a broad range of instruments, including not only spot transactions, but also outright forwards, and swaps and potentially futures, options and other derivatives. The literature is also clear on the need to differentiate the tax rate by instrument and market to ensure that it corresponds to around the same percentage of transaction costs in each market.

Where disagreement still exists in the literature, it centres on whether the tax should be at the point of trade, which is still highly decentralised, or at the point of settlement (which is increasingly centralised). If it is applied at the point of trade, then the question arises of whether taxation should be based on the nationality of the trader or on the market in which they are operating. The literature contains persuasive arguments on both sides. Either way, most authors suggesting this approach concur that an international agreement would be necessary to prevent migration to non-compliant jurisdictions. By contrast, those arguing for application at the point of settlement provide persuasive evidence that this could enable implementation by individual countries or groups of countries (notably the EU) without a full international agreement. This might also make implementation more feasible. However, broader application would still be desirable to avoid currencies disadvantaging themselves relative to those not included.

The third question, on the revenue-raising potential of FTTs, has generated a very large literature. It has also generated an enormously wide range of estimates of revenue potential, depending on the assumptions made about the base of the tax, tax rates and the extent to which the base would reduce as a result of the tax. Most notable is the remarkable lack of consensus in the literature about the appropriate assumption for the elasticity of volume with respect to the tax. Fortunately, recent work has provided credible estimates of both the underlying transaction costs in different markets and the relevant elasticities. We construct a meta-estimate of revenue potential by applying the central estimates for transaction costs and elasticities drawn from empirical studies to the most recent data on the size of the various markets.

Our results suggest that the revenue potential of an FTT is still significant. A Tobin tax of 0.005 per cent applied only to spot, outright forward and swap foreign exchange markets could raise around $25 billion if applied globally, or US$11 billion (£7.5 billion) if applied to all forex transactions occurring in the UK. If a financial transaction tax equivalent to 10 per cent of existing levels of transaction costs in each market was to be applied globally and across the board to equity, forex and derivative markets (both on and off exchanges), the revenue potential could be as high as US$482 billion, of which US$163 billion (£112 billion) would accrue to the UK. Of course, to realise such sums would require international agreement, at least amongst the key financial centres – unilateral implementation would raise much smaller (but still potentially significant) sums. Moreover, it is likely that long-run elasticities will be larger than short-run elasticities, as market actors find mechanisms of avoiding the tax. Certainly the existing literature suggests considerable care needs to be take in the design of the tax to minimise avoidance opportunities, and tax authorities would need to monitor avoidance and modify or supplement measures as appropriate (as exemplified by the UK's introduction of the Stamp Duty Reserve Tax to prevent avoidance of the UK stamp duty on share transactions). However, we do not find compelling evidence that these activities would be any more onerous or costly than the normal activities undertaken by tax authorities. We therefore conclude that a Tobin tax could make a significant contribution to the revenues of countries that impose it.

Our final question concerns the incidence of the Tobin tax. Again, we find the literature somewhat wanting on this topic. Several papers make strong assertions about the progressive nature of the tax, whilst others make equally strong assertions that the entire tax is likely to be passed on to consumers – rarely is evidence for either position presented. There is general agreement in the literature that the initial brunt of the tax would be borne by wholesale traders, particularly those involved in short-term foreign exchange transactions. Moreover, several papers point out that different kinds of institutions have very different levels of involvement in these transactions. In particular, banks and hedge funds are much more involved in short-term trading than insurance and pension funds and would therefore pay a larger share of tax. However, the final incidence depends on the extent to which these institutions can pass on the tax. This, in turn, depends on the extent of competition in different segments of the financial sector. It seems likely that, in the long run, a significant proportion of the tax would end up being passed on to consumers in the form of lower returns or higher spreads, but we currently have few credible estimates of what proportion that might be. Nonetheless, even assuming that the tax is ultimately passed on in the form of lower returns and a higher cost of capital, this will have a disproportionately large impact on the owners of capital. Since the distribution of capital is significantly more unequal than the distribution of income, it would seem likely that the medium-run incidence of the tax is no worse, and quite possibly significantly more progressive, than other forms of taxation. On the other hand, recent evidence does suggest that similar taxes on capital can lower wages, including those of the lower skilled. If this also applied to an FTT then the long-run incidence of the tax might be somewhat less progressive.

Given the answers that we have been able to glean from the literature on our four questions, our overall conclusion is moderately positive. Although the literature is far from conclusive on many points, it seems clear that an FTT is implementable and could make a non-trivial contribution to revenue in the major financial economies. It seems unlikely to stabilise financial markets, but, if appropriate designed, unlikely to destabilise them either; and, although a multilateral agreement between the key economies is clearly preferable, it would not be impossible to implement unilaterally, at least for a major economy. The incidence of an FTT would not be as progressive as its proponents claim, but we have no reason to believe that it would be significantly worse than most alternatives, nor that it would be any more difficult to collect. In short, we conclude that, somewhat contrary to our initial instincts, a financial transaction tax may not be such a bad idea after all.

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